NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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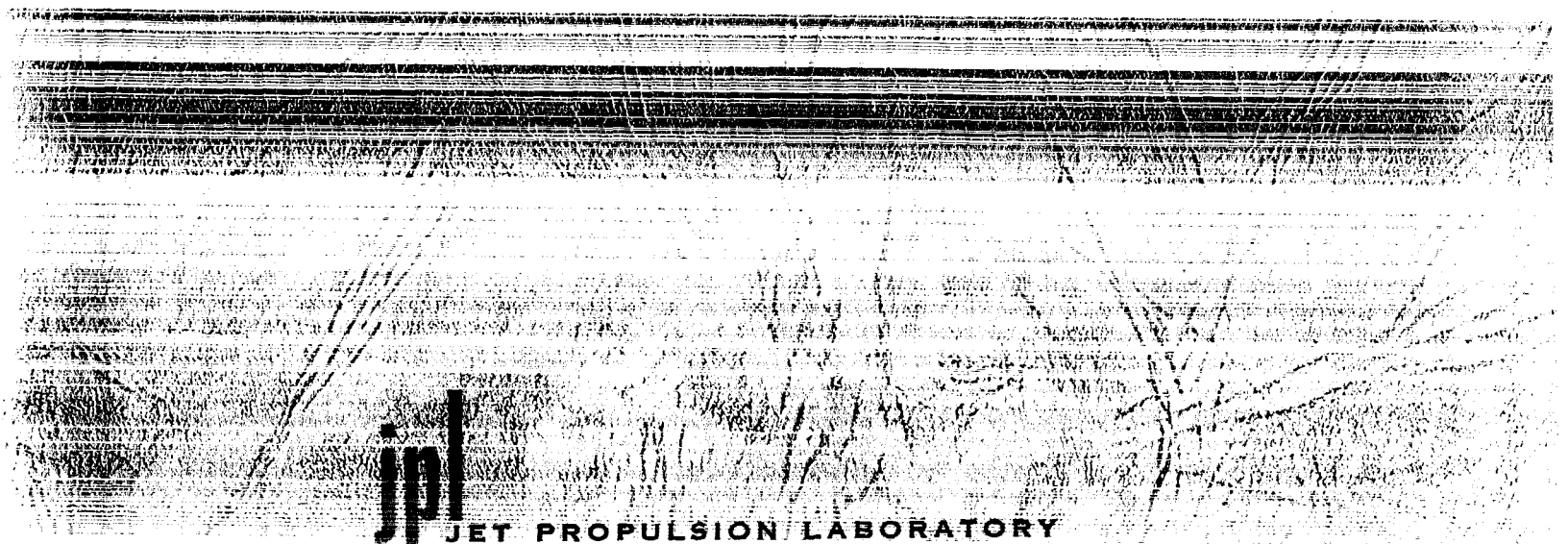

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

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ABSTRACT

The effects of thermal sterilization on approximately 160 polymeric products used on the *Ranger* and *Mariner* spacecrafts are discussed. After classification according to function, the products were first subjected to a preliminary screening program that consisted of a 36-hr exposure at 145°C in dry nitrogen, with a limited amount of testing; this program screened out products of low thermal stability. Those that met the preliminary thermal compatibility criteria were subjected to the more severe JPL type approval procedure: 3 cycles of 36-hr exposure at 145°C in dry nitrogen. More extensive testing was conducted in this phase of the program both before and after thermal exposure to determine changes in the physical, mechanical, electrical and thermal properties of the products.

A discussion of the criteria used to evaluate the products is presented, in addition to the specific compatibility ratings assigned to each product as a result of the tests.

I. INTRODUCTION

The requirement to sterilize planetary spacecraft has necessitated the selection of materials that can resist the sterilization environment. Experience in the past has shown that polymeric products, which serve in many capacities on spacecraft, can be seriously affected by the environments of decontamination and heat sterilization (Ref. 1). It is of paramount importance, then, that polymeric products capable of withstanding the rigors of such environments be singled out for use. The sterilization procedure as specified consists of a decontamination process using ethylene oxide (ETO) diluted with an uninflammable gas such as dichlorodifluoromethane (Freon 12 or Genetron 12), followed by a process of thermal sterilization.

This Report concerns an investigation of the effects of thermal sterilization on polymeric products. The term "polymeric product" used here specifies a formulated or compounded organic polymer sold under a trade name. In its raw or basic state, an organic polymer has limited usefulness, but cured (vulcanized), and, in most cases, compounded with other materials, certain desirable properties or responses can be obtained.

In selecting polymeric compositions that can be used in sterilized spacecraft, a convenient starting point would be a list of products with which a certain extent of familiarity is established. The polymeric products dealt with in this Report are materials used previously in the *Ranger*

and *Mariner* spacecraft, and none of the materials investigated was chosen for study on the basis of a manufacturer's recommendation regarding sterilizability, and none had been specifically formulated to be a heat sterilizable material. They were simply off-the-shelf items that had some usage on non-sterilized JPL spacecraft, which were investigated to determine whether they could withstand a sterilization environment.

Information on the thermal stability of relatively pure polymers is available, and extensive studies (Ref. 2 through 8) have been made on the thermal degradation of many basic polymers. The temperatures used in these investigations are necessarily high (200–1000°C) to bring about appreciable degradation in the polymer in a reasonable time; the relative thermal stability of polymers can be obtained from such experiments. Madorski (Ref. 2), for example, has listed the temperatures (T_h) at which a number of high polymers lose half of their original weight in a vacuum after 30 min of heating. According to his tables, T_h for Teflon (polytetrafluoroethylene) is 509°C and for polyisoprene it is 323°C, which indicates Teflon's greater thermal stability as compared with polyisoprene.

The so-called "heat resistance temperature" is also discussed in the literature on the thermal behavior of polymeric products. Heat resistance connotes a capacity of the polymer to retain unchanged its structure and properties (mechanical, physical, thermal, and electrical) at elevated temperatures, for extended periods. The Encyclopedia issue of *Modern Plastics,* for example, provides data on the resistance to heat temperatures of relatively pure polymers or polymeric materials of known composition, but without indicating the sources for the methods, standards, and the extent of testing used to arrive at the published results. This limits the degree of confidence placed in these data as useful engineering values.

Although the general chemical type of polymers used in the products investigated is known, the nature of the compounding ingredients, the methods of processing, the nature of the curing or vulcanizing agents used with castable polymers, and the particular grade or variation of the base polymer is not available because of the proprietary nature of this information. The heat resistance or thermal stability of the base polymer provides no indication of the compounded polymer's reaction towards heat, because of the new chemical environment created by the compounding ingredients. At elevated temperatures, then, a rapid progression of chemical reaction that is independent of the direct action of heat may take place between the polymer and the added chemical ingredients, causing early degradation of the polymer. Because of the difficulty in predicting the thermal behavior of polymeric products, actual testing is unavoidable.

Because the study of 160 products under thermal sterilization is a considerable task, simple and rapid methods of testing and evaluation were used to save time and reduce costs.

The candidate products were first classified into eight categories according to their functions. The eight categories are: adhesives, coatings, elastomers, encapsulants, films, lubricants, reinforced plastics, and tapes. Pertinent tests were then assigned to each category. The tests used were simple and standard, and their number was kept to a minimum. In spite of these efforts to reduce costs, more than 6500 specimens were prepared and tested.

Prior to the heat sterilization tests, the majority of the products were subjected to a screening program that eliminated those of poor thermal stability. This program consisted of a 36-hr exposure to a temperature of 145°C in dry nitrogen. Products that met the preliminary screening criteria were exposed to the JPL type approval test procedures for heat sterilization, hereinafter called "thermal exposure" (JPL Spec. XSO-30275-TST-A), which consisted of 3 cycles of 36-hr exposure at 145°C in dry nitrogen. Both the temperature and the duration of each cycle were altered slightly for the present investigation as noted below.

After thermal exposure, the properties of the samples were tested, and the values obtained were compared with those obtained for unexposed samples. Ratings of the thermal stability or thermal compatibility of the products were then made, assessing the degree of change in the measured properties. Accordingly, products were rated compatible, marginal or not compatible.

Ratings were assigned to distinguish those products that could take the thermal treatment from those that could not. Results show that no compound was unaffected by thermal exposure. Initial properties suffered changes in all cases, which was not unexpected, and the degree of change in these properties distinguished one product from another.

A set of criteria or standards by which the products could be rated was necessary. The criteria or standards must be justified, of course. For each class of products, therefore, compatibility criteria were set. The principal

reason for the choice of these criteria was the performance thought to be required of each class of products. In the absence of concrete, well-defined engineering or performance requirements, this was the only recourse. The element of subjectivity and arbitrariness attached to this method is acknowledged.

It is hoped that the materials or design engineer will make use of the data presented here to arrive at conclusions based on his own specific performance requirements for the thermal compatibility of these products.

It should be recognized that rating a product compatible with the thermal sterilization condition does not necessarily qualify it for use on spacecraft. This use involves other requirements as well, such as compatibility with ETO, resistance to radiation, and stability in a vacuum.

II. SCOPE OF INVESTIGATION AND PLAN OF REPORT

A. Scope

The effects of thermal exposure on some 160 proprietary polymeric products were studied in accordance with the JPL Specification XSO-30275-TST-A (April 1963), which defines the "dry heat sterilization compatibility testing of assemblies for spacecraft having the possibility of planetary impact." However, slight changes were made in the time and the temperature specified to afford a margin of safety. The duration of each cycle was extended from 36 to 40 hr, and the exposure temperature was raised from 145 to 149°C (300°F).

The influence of heat exposure in a nitrogen atmosphere on the mechanical, physical, electrical, and thermal properties of various functional classes of materials was investigated by comparing the properties before and after the specified thermal treatment. In most cases, the products chosen had been used previously on unsterilized *Ranger* and *Mariner* spacecraft.

Preliminary testing was performed to screen out products of low thermal stability. These tests were carried out after an exposure of 40 hr at 300°F (1 cycle of the 3-cycle thermal exposure test). Both the number of tests and the number of specimens tested were kept to a minimum. About 20 products were eliminated by the preliminary screening tests.

This Report concerns only those tests used to determine compatibility of the products with the thermal sterilization requirements and procedures. The effects on these products of decontamination with ETO is not included, because this phase of sterilization is outside the scope of the present investigation.

B. Plan of Report

The Report consists of two main parts: the text proper and the appendixes. The text provides summarized test results in tabular form for each class of products (Tables 4 through 14); these tables include compatibility ratings. The test data reported pertain to thermal exposure testing only, and are average values. Other tables and graphical representations are also used in the text, to supplement the general discussion. Materials, procedures and tests are briefly discussed in Section III. Compatibility criteria and discussion of results are given in Section IV.

Detailed results of the preliminary screening tests are given in Appendix A, and the details of the thermal exposure test results are given in Appendix B. The data are presented in tabular form. Appendix C consists of information on those products that required preparatory treatment before their use as test samples. Adhesives, coatings, and encapsulants are classes of such products. Mixing ratios, pot lives, and cure conditions for the products are included in this Appendix.

III. EXPERIMENTAL SECTION

A. Sample Materials and Preparation of Samples for Testing

The polymeric products tested in this program were proprietary in most cases; the nature of the basic polymeric constituents, however, was known.

The constituent basic polymers of each category are listed in Table 1. Test samples were prepared in accordance with the sizes and shapes specified in the standard test methods used.

Table 1. Basic polymers

Category	Constituent basic polymer
Adhesives	Epoxy, neoprene, polyester, silicone, vinyl
Coatings	Alkyd (polyester), epoxy, phenolic, polyimide, polyurethane, silicone
Elastomers	Butyl, fluorocarbon, fluorosilicone, neoprene, nitrile, silicone
Encapsulants	Epoxy, polyurethane, silicone
Films	Polyester, polyimide, poly(vinyl fluoride)
Lubricants	Hydrocarbon, phthalate ester, silicone
Reinforced plastics	Diallyl phthalate, epoxy, phenolic
Tapes	Glass fabric/epoxy, glass fabric/silicone, Mylar/rubber

The adhesives, coatings and encapsulants required such preliminary handling as mixing and degassing before test specimens or castings could be prepared. The elastomers, with the exception of a few room temperature vulcanizing (RTV) materials, were obtained premolded in 1/8- to 1/4-inch thick sheets. The films, lubricants, reinforced plastics and tapes were obtained ready for use.

Adhesives and tapes were applied to anodized aluminum panels that were cleaned repeatedly with CP acetone, and dried with clean, lint-free tissue paper. Coatings were applied to anodized aluminum panels to evaluate their mechanical properties and applied to bare aluminum panels for electrical testing. Both types of panels were cleaned in the same manner as that used for tapes.

B. Test Equipment

Standard equipment was used in most cases and needs no description. Special test equipment included the vacuum ovens (National Appliance Co., Model 5850) used for thermal cycling, and the vacuum pumps (Kinney, Model 5KC) used to evacuate the ovens; these pumps have a free air capacity of 8 ft^3/min. Automatic thermostats with an accuracy of $\pm 2°F$ regulated the oven temperatures. The balance (Mettler, Model H 15) measured changes in weight to ± 0.1 mg, and the micrometer (Ames Micrometer Dial Gage) measured changes in volume to ± 0.1 ml. An Instron tensile tester was used to measure tensile strengths.

C. Thermal Exposure Procedure

The vacuum ovens were preheated to 300 $\pm 2°F$ and the samples were placed on metal racks inside. The oven doors were clamped, and the ovens evacuated to 28.5 in. of mercury with a Kinney vacuum pump. The ovens were then purged with dry nitrogen of extra high purity; evacuation and purging were repeated two more times, ending with the nitrogen purge. A flow of nitrogen through the ovens was kept during each entire cycle at a flow rate of approximately 10 ml/min.

The performance of the vacuum ovens was evaluated by mass spectrometric analysis of the oven atmosphere. The gases were analyzed at the beginning and at the end of a cycle with and without samples in the ovens. The following results were typical:

beginning of cycle, no samples: <0.1 mol % air;

end of cycle (40 hr), no samples: 0.2 mol % air (approximate);

beginning of cycle, with samples: 0.9 to 1.0 mol % air;

end of cycle (40 hr), with samples: 1.4 to 1.7 mol % air.

The percentage of air was calculated from the oxygen peak of the mass spectrogram.

Analysis of the high purity nitrogen from the cylinder by mass spectrometry did not show more than 0.001 mol % air. The analyses given above indicate an adequate, but not perfect, purging of the oven; a probable slight leakage of air into the oven (0.1 mol % during

Table 2. Preliminary screening tests

Test	Adhesives	Coatings	Elastomers	Encapsulants	Films	Lubricants	Plastics	Tapes	Standard
Shear strength	X								FTMS #175, Method 1033.1T
Adhesion (peel, scrape)		X						X	ASTM D1000-62, ASTM D2197-65T
Flexibility		X							FTMS #141, Method 6223
Hardness		X	X	X					ASTM D676-59T
Tensile strength			X	X	X		X		ASTM D412-62T, ASTM D882-63T, ASTM D638-61T
Modulus			X	X	X		X		ASTM D412-62T, ASTM D882-63T, ASTM D638-61T
Dimensional change				X					Direct measurement using an Ames dial gage micrometer
Elongation							X		ASTM D638-61T
Weight loss	X		X	X	X	X	X	X	Direct weight measurement using a Mettler Model H15 balance

Table 3. Thermal exposure (3 cycle) evaluation tests

Test	Adhesives	Coatings	Elastomers	Encapsulants	Films	Lubricants	Plastics	Tapes	Standard
Tensile strength			X		X		X	X	ASTM D412-62T, ASTM D882-61T, ASTM D638-61T
Elongation			X		X		X		ASTM D412-62T, ASTM D882-61T, ASTM D638-61T
Compression set			X[a]						ASTM D395-61, Method B
Tear resistance					X				ASTM D624-54
Adhesion (peel, scrape)		X						X	ASTM D2197-65T, ASTM D1000-62
Tensile shear strength	X								FTMS #175—Method 1033.1T
Hardness			X	X			X		ASTM D676-59T, ASTM D1706-61, ASTM D785
Volume change				X					Direct measurement using an Ames dial gage micrometer
Viscosity/penetration						X			ASTM D2196-63T, ASTM D217-60T
Volume resistivity		X	X	X	X		X	X	ASTM D257
Surface resistivity		X	X	X	X		X	X	ASTM D257
Dielectric strength		X	X	X	X		X	X	ASTM D257
Flexibility		X							FTMS #141, Method 6223
Weight loss			X	X	X	X	X	X	Direct weight measurement using a Mettler Model H15 balance

[a]This test was performed, but not used in evaluation of the product.

40 hr); a probable desorption, caused by heat, of absorbed or adsorbed gases from the samples, the amount of desorption increasing with time.

D. Tests Used

The tests and methods used for each class of products during the preliminary screening program and the thermal exposure test procedure are given in Tables 2 and 3, respectively. Although standard tests were used during the preliminary screening program, specimen dimensions varied from the requirements for reasons of speed and convenience in testing. In the thermal exposure program, however, tests were performed in full compliance with the applicable standard test methods. Weight losses were measured to an accuracy of ± 0.1 mg, and volume change measurements were accurate to ± 0.1 mil.

IV. DISCUSSION

A. Criteria and Rating

The selection of polymeric materials for use in sterilized spacecraft involves judging or rating, and the latter necessitates the use of criteria by which to rate. The lack of established criteria that could be used to rate the products made construction of such criteria necessary. Because mechanical properties of polymers are dependent on time, temperature, previous history, and environment, a change in properties in the order of $\pm 15\%$ can be expected as a result of these variables. The degree of change because of thermal exposure alone, then, could be only estimated. The final bases for the criteria adopted were performance requirements for the class of materials under investigation, an estimation of product performance, and an evaluation of the content and accuracy of the standard tests. The criteria developed from these considerations established the ratings of compatible, marginal, and not compatible with the heat sterilization environment.

Because the criteria vary from one class to another, they are presented separately in the discussion for each class. The criteria used for mechanical properties (hardness excepted), electrical properties, and weight loss, however, are common to all classes, and are given here.

1. Electrical Properties

Threshold values were set for electrical values, as follows:

volume resistivity: 10^7 Ω-cm

surface resistivity: 10^7 Ω

dielectric strength: 200 v/mil

Products were considered compatible where the three electrical measurements remained greater than the threshold values, the decrease in electrical resistivities was less than about 10^3 Ω, and the loss in dielectric strength was no more than 25% of the original value. They were rated not compatible where any one of these criteria was not met. Products with borderline values were rated as marginal. No product used as an insulator dropped below the resistivity thresholds. In very rare instances, dielectric strength dropped below the threshold value. The dielectric strengths of some products were below 200 v/mil before the test, and remained below the threshold value after thermal sterilization. Such cases were considered compatible because the original property or quality of the product was not being assessed.

2. Mechanical Properties and Weight Loss

The following criteria for mechanical properties and weight loss were applied to the products after exposure to the thermal environment:

1. Compatible: the product retained 80% or more of its original mechanical properties; weight loss was less than 1%;
2. Marginal: the product retained 70 to 80% of its original mechanical properties; weight loss was between 1 and 4%;
3. Not compatible: the product retained less than 70% of its original properties; weight loss was more than 4%.

Table 4 (Cont'd)

No.	Commercial designation	Material type	Manufacturer	Shear strength[b], psi		Comments	Compatibility rating	References to manufacturer's literature
				Control	After thermal exposure			
20	FM 96	Epoxy/polyamide nylon fabric	American Cyanamid	945	1120	Nylon fabric-supported tape adhesive	C	10M
21	FM 1044	Epoxy/no polyamide	American Cyanamid	2310	2625	Unsupported film adhesive	C	11M
22	GT 200	Polyester	Schjedahl	157	164	Chlorinated solvent; low solid content; Mylar adhesive	C	115M
23	HT 424	Epoxy-phenolic	American Cyanamid	1672	1340	Non-supported adhesive film	M	12M, 13M
24	Hysol 5150/3690	Epoxy/modified amine	Hysol of Calif.	1720	2537	Darkens	C	82M
25	Number A2 Adhesive/A	Epoxy-aluminum	Armstrong Prod.	804	1440	Yellows	C	5M, 6M
26	PC 12-007 A/B	Epoxy/amine	Hysol of Calif.	705	456	Used as circuit board coating; slight darkening	NC	84M
27	Proseal 501 Adhesive	Polysulfide	Coast Proseal	174	64	High weight loss (>10%)	NC	15M
28	RTV 102	Silicone	General Electric	172	361	One part material. Thixotropic; weight loss >2%	M	73M
29	RTV 108	Silicone	General Electric	115	190	One part material	C	73M
30	RTV 140	Silicone	Dow Corning	180	235	One part material	C	20M
31	RTV 891	Silicone	Dow Corning	175	240	One part material	C	19M

About 60% of the adhesives tested were considered compatible. Among these are enough structural and non-structural adhesives to serve as candidates for spacecraft use. Some of the adhesives rated M because of weight losses might be "cleaned" by thermal, vacuum, or thermal/vacuum treatments, and, as a result, advanced into the C category (Ref. 9 and 10).

2. Coatings

A summary of thermal exposure test results for coatings is given in Table 5. Detailed data for the preliminary screening program are found in Table A-2 of Appendix A, and detailed test results are provided in Table B-2 of Appendix B.

The products listed in Table 5 are not all coatings. Products No. 8, 20, 22, and 23 are inks, and products No. 9 and 10 are film lubricants. They are listed with coatings because they were subjected to the same screening tests.

Coatings were rated on the bases of the scrape adhesion, flexibility, and electrical (volume and surface resistivities and dielectric strength) tests, along with observations of surface conditions. Function of the material was considered in rating the coatings because they are used for wire enamels and conformal coatings, and in thermal control. Color change, for instance, was considered important in rating thermal control coatings, but less important in rating inks or wire enamels. Weight losses were not used in rating for the reason discussed under solvent-based adhesives. The coatings were rated:

1. C if, after thermal exposure,
   a. Scrape adhesion was more than 1.5 kg,
   b. Passed the flexibility test,
   c. There were no surface changes (blisters, pinholes), or color changes (applicable to thermal control coating only),
   d. Electrical criteria were met.
2. M where either
   a. Scrape adhesion was 0.5 to 1.5 kg,
   b. Electrical properties were borderline.
3. NC where either
   a. Scrape adhesion was less than 0.5 kg,
   b. Failed the flexibility test,
   c. Failed the surface conditions requirements,
   d. Failed any one of the electrical criteria.

Alkyds, epoxies, phenolics, polyurethanes, polyimides and silicones were the different kinds of base resins used in the coatings tested. Using the criteria above, three of the six alkyd-based coatings in Table 5 were rated NC: two (No. 1 and 2) because of blister formation, and one (No. 8), an ink, because it failed the flexibility test; the remaining three were rated C. Five epoxy coatings (No. 3, 4, 5, 6, and 11) were rated NC, because the first four failed the flexibility test, and the last one (No. 11) failed the dielectric strength test; also No. 6 retained less than 75% of its initial dielectric strength. Two of the epoxy-based coatings (No. 4 and 5) were thermal control coatings, which yellowed slightly after thermal exposure. One of the three phenolic-based coatings (No. 27) did not pass the preliminary screening tests for flexibility and adhesion; another (No. 10) was a molybdenum-sulfide-filled film lubricant that passed the compatibility criteria for coatings, without test as a lubricant. The other phenolic-based coating (No. 18), a thermal control coating, could be rated C; the electrical tests, which it failed, were not applied to the rating. Of the three polyurethane-based coatings, one (No. 19) was rated NC, having failed the preliminary screening tests for flexibility and adhesion. The other two (No. 12 and 29) were considered C. None of the silicone-based coatings could be rated C because they exhibited low adhesion, generally. One (No. 24) was a primer for room temperature vulcanizing (RTV) silicones; another (No. 21) was water-repellent, of doubtful use as a coating material in spacecraft, and certainly not for use on non-porous surfaces. The polyimide varnish (No. 25) showed satisfactory resistance to thermal exposure and was rated C.

With some exceptions, the volume resistivities of the coatings used for insulation increased after thermal exposure (Fig. 1). In general, those that showed improvement in volume resistivity also improved in dielectric strength (Fig. 2). Two exceptions were Pyre-ML varnish (No. 25, Table 5), and Eccosil 33 (No. 14), which lost about 25% and 9%, respectively, of their initial dielectric strengths. The values after thermal exposure, however, were much above the threshold figure.

About 42% of the coatings tested were rated compatible.

3. Elastomers

A summary of thermal exposure test results for elastomers is given in Table 6. Detailed data for the

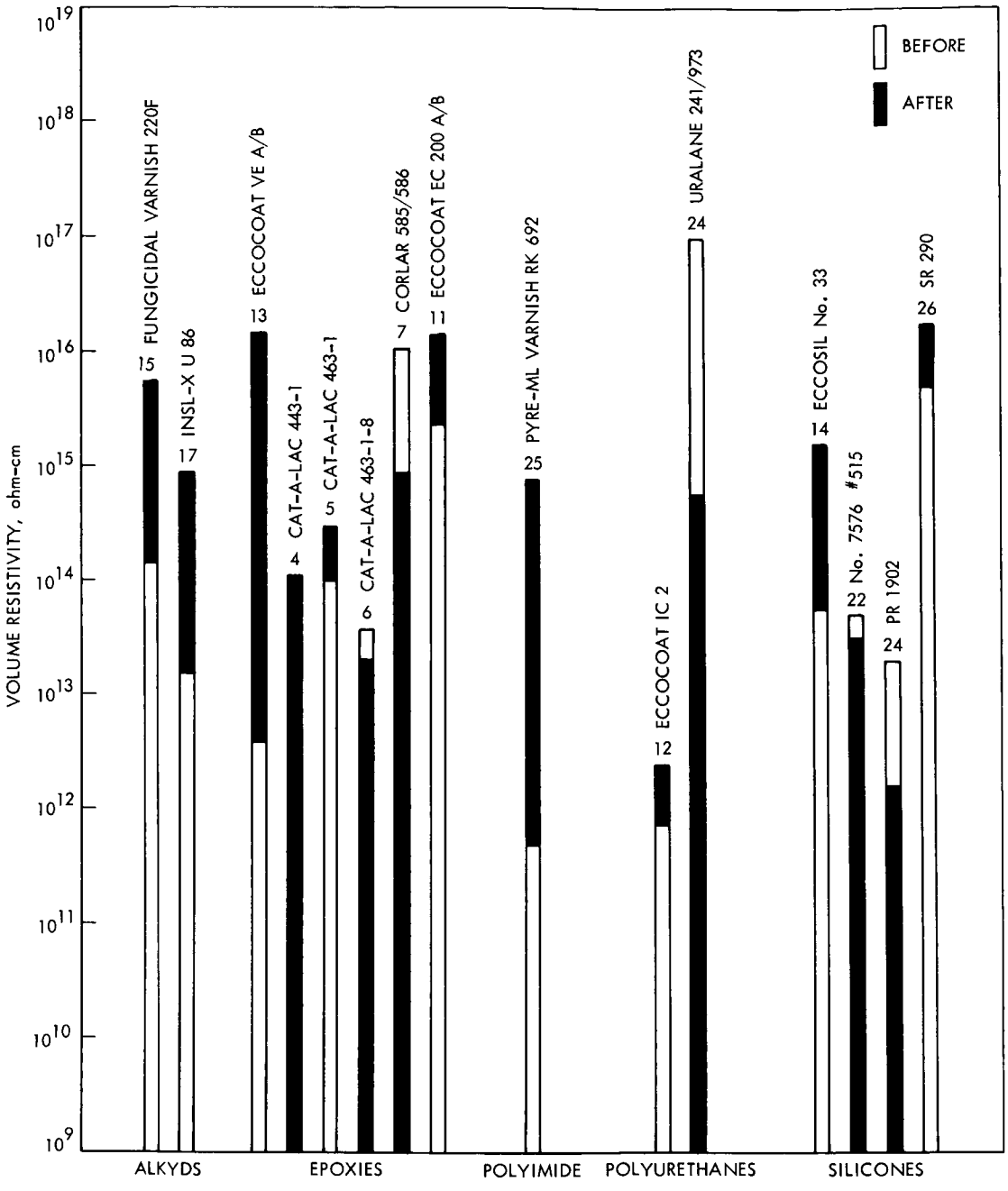

Fig. 1. Volume resistivities at room temperature of coatings before and after thermal exposure (3 cycles, 40 hr each at 300°F in nitrogen)

preliminary screening program are found in Table A-3 of Appendix A, and detailed test results are provided in Table B-3 of Appendix B.

Tests used in rating the elastomers included ultimate tensile strength and elongation, hardness, weight loss, and electrical properties. Although the percent compression set of all the elastomers was determined, the lack of adequate data for some made a comparative evaluation impossible, and the values obtained were not used in rating. In certain cases, the available test samples were too thin, and had to be prepared by piling up specimens. Results in such instances were erratic, and, therefore, not reported.

Table 5. Summary of test results for the thermal sterilization procedure[a] on coatings and inks

No.	Commercial designation	Material type	Manufacturer	Mechanical properties				Electrical properties						Surface condition after thermal cycling	Comments	Compatibility rating	References to manufacturer's literature
				Scrape adhesion[b], kgm		Flexibility[c] (cold cracking)		Volume resistivity[d], Ω - cm		Surface resistivity[d], Ω		Dielectric strength[d], v/mil					
				Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure				
1	Alkenex Varnish 9522	Alkyd polyester	General Electric	6.8	9.0	Pass	Pass	—	—	—	—	585	640	Darkening of color; blisters	Blisters prevented resistivity measurement	NC	78M
2	B-224-2 Tuffernell Varnish	Alkyd	Westinghouse	>10.0	9.3	Pass	Pass	6.81×10^{14}	—	4.25×10^{15}	—	1550	1810	Darkening of color	Blisters on electrical samples	NC	131M
3	B-276 Clear Air Drying Varnish	Epoxy	Westinghouse	—	—	—	—	—	—	—	—	—	—	Yellowed	Softens and runs during preliminary thermal exposure	NC	131M, 132M
4	Cat-A-Lac 443-1 Gloss White	Epoxy/amine	Finch Paint & Chemical	5.0	8.5	Pass	Fail	1.2×10^{14}	1.0×10^{14}	1.1×10^{15}	3.43×10^{14}	1463	1125	White changes to cream color	Gets brittle after thermal exposure	NC	62M
5	Cat-A-Lac 463-1 Flat White	Epoxy/amine	Finch Paint & Chemical	5.0	>10.0	Fail	Fail	9.98×10^{13}	4.58×10^{14}	9.78×10^{14}	7.41×10^{14}	1106	1113	White changes to dark cream color	Gets brittle	NC	62M
6	Cat-A-Lac 463-1-8 Flat Black	Epoxy/amine	Finch Paint & Chemical	>10.0	>10.0	Fail	Fail	5.68×10^{13}	3.0×10^{13}	2.83×10^{15}	6.33×10^{10}	930	526	No change in color	Gets brittle	NC	62M
7	Corlar 585/586	Epoxy/amine	Du Pont	2.0	2.3	Pass	Pass	9.90×10^{15}	9.10×10^{14}	5.52×10^{14}	3.09×10^{14}	373	300	No change observed	—	C	—
8	D 25 W2 Speedprint Ink	Alkyd	Sherwin-Williams	1.2	1.5	Fail	Fail	8.00×10^{14}	7.32×10^{15}	6.65×10^{14}	6.19×10^{14}	715	345	Darkening of color	Gets brittle	NC	123M
9	Electrofilm Lube-Lok 2396	Sodium silicate/MoS_2	Electrofilm Corp.	1.5	1.5	Pass	Pass	7.39×10^{7}	6.71×10^{7}	3.06×10^{5}	3.09×10^{5}	—	—	Slight darkening of color	Very low resistivities; not for insulation	C	41M
10	Electrofilm Lube-Lok 4306	Phenolic/MoS_2	Electrofilm Corp.	6.3	3.8	Pass	Pass	4.81×10^{16}	4.05×10^{16}	2.24×10^{14}	3.02×10^{14}	805	716	No change	—	C	42M, 43M
11	Eccocoat EC 200 A/B	Epoxy/amine	Emerson Cuming	0.5	4.8	Pass	Pass	3.38×10^{15}	1.04×10^{16}	2.57×10^{15}	2.70×10^{15}	160	160	Yellowing	Low dielectric strength; possibly corrosive	NC	54M
12	Eccocoat IC 2	Polyurethane	Emerson Cuming	6.8	7.6	Pass	Pass	8.47×10^{11}	3.89×10^{12}	5.31×10^{13}	1.10×10^{13}	463	873	Yellowing	—	C	44M, 46M
13	Eccocoat VE A/B	Epoxy	Emerson Cuming	6.5	5.3	Pass	Pass	5.85×10^{12}	1.29×10^{16}	2.73×10^{11}	4.07×10^{14}	711	1136	Darkening of color	—	C	45M
14	Eccosil No. 33	Silicone	Emerson Cuming	0.5	1.0	Fail	Pass	7.1×10^{12}	1.38×10^{15}	6.11×10^{13}	6.50×10^{13}	1000	900	No change	Low adhesion	M	—
15	Fungicidal Varnish 220F	Alkyd-salicylanilide fungicide	Westinghouse	2.3	3.3	Pass	Pass	1.41×10^{14}	7.13×10^{15}	6.65×10^{14}	7.74×10^{14}	446	693	Darkening of color	—	C	131M
16	Hi-Heat Aluminum Paint 171-A-28	Silicone/aluminum	Fuller Paint Co.	0.5	0.5	Fail	Pass	—	—	—	—	—	—	No change	Conductive; low adhesion	M	63M
17	Insl-X U86	Melamine-alkyd modified	Insl-X Products	1.5	7.5	Pass	Pass	1.83×10^{13}	9.19×10^{14}	2.44×10^{14}	1.44×10^{14}	1297	1722	Severe darkening of color	—	C	86M
18	Interchemical 12412	Phenolic-butyrate	Interchemical Corp.	5.0	9.9	Pass	Pass	2.05×10^{15}	Shorted	7.74×10^{14}	Shorted	283	125	No change observable	Hot for electrical insulation	C	87M
19	Laminar X500	Polyurethane	Magna Coatings	—	—	—	—	—	—	—	—	—	—	Yellowing after preliminary screening	Fails flexibility and adhesion tests; preliminary thermal exposure	NC	—
20	Number 73-X Ink	Not revealed	Independent Ink Co.	<0.5	1.5	Pass	Pass	1.16×10^{10}	6.70×10^{9}	8.77×10^{13}	1.90×10^{14}	24	21	No change observable	Low adhesion	M	85M
21	Number 445 Silicone Water Repellent	Silicone	Sinclair	1.8	0.8	Pass	Pass	—	—	—	—	—	—	No change observable	—	NC	124M
22	Number 7576-#515	Silicone-alkyd	Fuller Paint Co.	3.5	4.5	Pass	Pass	6.67×10^{13}	4.50×10^{13}	1.05×10^{14}	2.50×10^{13}	266	142	No change observable	Low dielectric strength; not for electrical insulation	C	64M, 65M
23	Perma-Dri Ink 177	Not revealed	Acme Marking Co.	<0.5	3.3	Pass	Pass	7.2×10^{9}	6.18×10^{9}	9.23×10^{6}	4.90×10^{6}	0	0	No change observable	Low resistivities; not for electrical insulation	C	1M
24	PR 1902	Silicone primer	Prod. Research Co.	<0.5	<0.5	Pass	Pass	2.76×10^{13}	1.86×10^{12}	3.24×10^{14}	2.05×10^{14}	426	480	Lightening of color	Colored outgassed material; this may affect other materials	M	111M, 113M
25	Pyre-ML Varnish RK692	Polyimide	Du Pont	3.1	3.3	Pass	Pass	6.83×10^{11}	8.46×10^{14}	5.26×10^{14}	5.13×10^{11}	800	590	No change observable	—	C	39M, 40M
26	SR 290	Silicone	General Electric	1.0	1.0	Fail	Fail	6.56×10^{15}	1.93×10^{16}	1.00×10^{15}	3.09×10^{15}	51	900	Yellowing	Low adhesion; cracks easily	NC	72M
27	Tuf-On 747-S	p-Phenyl phenol aldehyde	Brooklyn Paint & Varnish	—	—	—	—	—	—	—	—	—	—	—	Fails adhesion and flexibility tests; preliminary thermal exposure	NC	14M
28	UC 11659	Silicone-aluminum	Pittsburgh Plate	—	—	—	—	—	—	—	—	—	—	—	As above	NC	109M
29	Uralane 241/973	Polyurethane	Furane Plastics	0.75	3.6	Pass	Pass	9.90×10^{15}	7.09×10^{14}	3.50×10^{14}	6.70×10^{14}	2293	3275	Yellowing	—	C	69M

[a]Three cycles of 40 hr each at 300°F in a nitrogen atmosphere. [b]ASTM D2197-63T. [c]FTMS #141, Method 6223. [d]ASTM D257.

Table 6. Summary of test results for the thermal sterilization procedure[a] on elastomers

No.	Commercial designation	Material type	Manufacturer	Mechanical properties								Electrical properties						Physical properties	Comments	Compatibility rating	References to manufacturer's literature
				Hardness[b], Shore A		Tensile strength[c], psi		Elongation[c], %		Compression set[d], %		Volume resistivity[e], Ω - cm		Surface resistivity[e], Ω		Dielectric strength[e], mil		Weight loss[f], %			
				Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure				
1	AMS 3195	Silicone	Rubatex	11.3	16.5	130	140	270	230	14.189	7.004	2.50×10^{15}	1.28×10^{14}	9.01×10^{14}	1.62×10^{14}	208	226	0.086	Silicone sponge	C	—
2	B-318-7/70	Butyl	Parker Seal Co.	72.2	65.8	1563	1380	292	271	20.781	16.137	4.13×10^{7}	5.41×10^{7}	2.67×10^{7}	3.14×10^{7}	<1.0	6.00	2.150		M	—
3	Butyl Rubber 805-70	Butyl	Plastic & Rubber Prod.	71.0	75.3	1530	1290	370	305	45.422	40.607	2.53×10^{6}	3.84×10^{6}	1.90×10^{6}	1.00×10^{6}	7.0	5.00	1.175		M	110M
4	Hadbar XB 800-71	Butyl	Hadbar, Inc.	47.3	65.5	1750	2055	713	202	34.035	6.389	4.53×10^{9}	8.24×10^{7}	7.42×10^{9}	6.60×10^{7}	46	58	0.677		NC	79M
5	Hadbar 1000/80	Fluorosilicone	Hadbar, Inc.	75.3	77.5	722	720	120	100	14.119	17.771	3.11×10^{14}	1.46×10^{13}	6.40×10^{12}	8.66×10^{12}	361	348	0.826		C	79M
6	Hadbar 4000/80	Dimethyl polysiloxane	Hadbar, Inc.	68.2	71.3	790	770	225	150	8.836	7.580	5.90×10^{14}	9.23×10^{13}	6.45×10^{14}	9.57×10^{13}	367	363	0.398		M	79M
7	Hadbar 5000/50	Fluorosilicone	Hadbar, Inc.	45.3	51.5	805	830	555	465	10.199	12.923	1.64×10^{13}	2.19×10^{13}	7.69×10^{13}	1.41×10^{13}	395	414	0.171		C	79M
8	L-308-80	Fluorosilicone	Parker Seal Co.	49.2	47.5	770	830	180	198	—	—	2.44×10^{14}	8.06×10^{12}	4.48×10^{14}	1.85×10^{13}	310	533	0.606	Gets lighter in color	C	104M
9	L-449-6/60	Fluorosilicone	Parker Seal Co.	50.5	48.7	930	840	195	190	5.637	9.908	9.74×10^{13}	1.79×10^{12}	3.71×10^{14}	1.90×10^{13}	331	513	0.517		C	108M
10	N-195-7/70	Nitrile	Parker Seal Co.	68.1	73.0	2810	2830	365	230	9.858	9.974	5.78×10^{9}	4.82×10^{9}	1.54×10^{11}	1.08×10^{11}	87	81	1.483		NC	107M
11	PMP 42011 AE	Neoprene—SBR	Pacific Moulded Prod.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	>6.0	High weight loss and change in mechanical properties after preliminary thermal exposure	NC	—
12	PMP 6035	Silicone	Pacific Moulded Prod.	68.0	63.8	800	885	245	200	10.660	10.402	1.66×10^{15}	2.57×10^{14}	9.77×10^{14}	1.43×10^{14}	414	410	0.000		C	—
13	PMP 6100	Silicone	Pacific Moulded Prod.	44.9	48.8	652	633	475	400	4.573	5.401	2.47×10^{15}	8.10×10^{13}	3.89×10^{14}	3.71×10^{13}	375	401	0.352		C	—
14	RC-5 No. 1852	Neoprene	Rubbercraft Corp.	57.0	71.3	2020	2172	252	142	—	—	6.72×10^{9}	6.30×10^{9}	9.56×10^{8}	2.99×10^{9}	64	19	1.837		NC	114M
15	RC-5 Silicone	Silicone	Rubbercraft Corp.	46.0	48.8	1320	1310	484	428	—	—	4.68×10^{13}	2.12×10^{14}	2.16×10^{15}	1.93×10^{15}	738	777	0.473		C	114M
16	RTV 501	Silicone	Dow Corning	39.3	28.5	310	210	175	190	—	—	3.16×10^{13}	7.37×10^{12}	4.43×10^{13}	2.68×10^{13}	422	467	1.793	A castable elastomer	NC	26M
17	RTV 615 A/B	Silicone	General Electric	21.8	28.2	120	145	140	120	—	—	4.08×10^{14}	1.85×10^{14}	1.36×10^{15}	1.47×10^{14}	444	499	0.308	A castable elastomer better used as encapsulant	C	77M
18	Rubber 1814	Butyl	W. G. Voit Rubber	67.5	64.5	210	110	505	495	27.012	66.825	1.43×10^{6}	7.82×10^{5}	8.36×10^{5}	6.14×10^{5}	2	12	1.495		NC	—
19	S-417-7	Silicone	Parker Seal Co.	66.3	64.3	885	507	290	154	11.148	10.682	1.14×10^{15}	1.96×10^{14}	3.97×10^{14}	8.26×10^{13}	407	405	0.090		NC	106M
20	Silastic 1410 (Heat Shrinkable)	Silicone	Dow Corning	49.0	50.8	1050	1210	395	355	20.030	27.030	(Same as below)		(Same as below)		(Same as below)			Transverse; test performed on preshrunk material	C	18M
	Silastic 1410 (Heat Shrinkable)	Silicone	Dow Corning	49.0	50.8	1303	1407	475	410	20.030	27.030	3.89×10^{14}	1.48×10^{15}	1.54×10^{15}	2.71×10^{15}	430	438	0.233	Longitudinal; preshrunk material tested	C	18M
21	Silicone Rubber 1050-70	Silicone	Plastic & Rubber Prod.	73.0	75.3	835	840	235	190	7.718	9.200	3.41×10^{12}	1.12×10^{13}	2.58×10^{13}	1.67×10^{13}	406	401	0.868		C	110M
22	Silicone Sheet 391-5	Silicone	Rubatex	57.3	62.2	535	675	195	150	5.714	7.260	2.34×10^{14}	9.98×10^{13}	4.02×10^{13}	4.23×10^{13}	422	421	0.099		M	—
23	SR 349-70	Nitrile	Stillman Rubber	—	—	—	—	—	—	—	—	—	—	—	—	—	—	>3.0	Fails mechanical property tests; preliminary thermal exposure	NC	—
24	SR 613-75	Butyl	Stillman Rubber	75.7	76.0	1860	1475	230	290	—	—	1.30×10^{4}	6.63×10^{4}	9.92×10^{3}	4.80×10^{4}	<1	1	1.298		M	126M, 127M
25	Viton B 60	Fluorocarbon	Du Pont	70.5	70.7	2370	1835	350	260	28.717	22.898	6.46×10^{13}	1.96×10^{13}	2.53×10^{14}	3.38×10^{13}	158	152	0.097		M	31M
26	Viton B 95	Fluorocarbon	Du Pont	92.8	92.7	2440	1990	120	100	34.564	35.449	6.76×10^{14}	1.13×10^{14}	5.00×10^{14}	1.57×10^{14}	239	271	0.150		C	31M
27	Viton 77-545	Fluorocarbon	Parker Seal Co.	72.8	72.5	2175	1975	240	205	24.453	21.066	1.78×10^{12}	2.09×10^{12}	1.01×10^{13}	4.50×10^{12}	134	127	0.131		C	105M

[a]Three cycles of 40 hr each at 300°F in a nitrogen atmosphere. [b]ASTM D676-59T. [c]ASTM D412-62T. [d]ASTM D395-61-Method B. [e]ASTM D257. [f]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

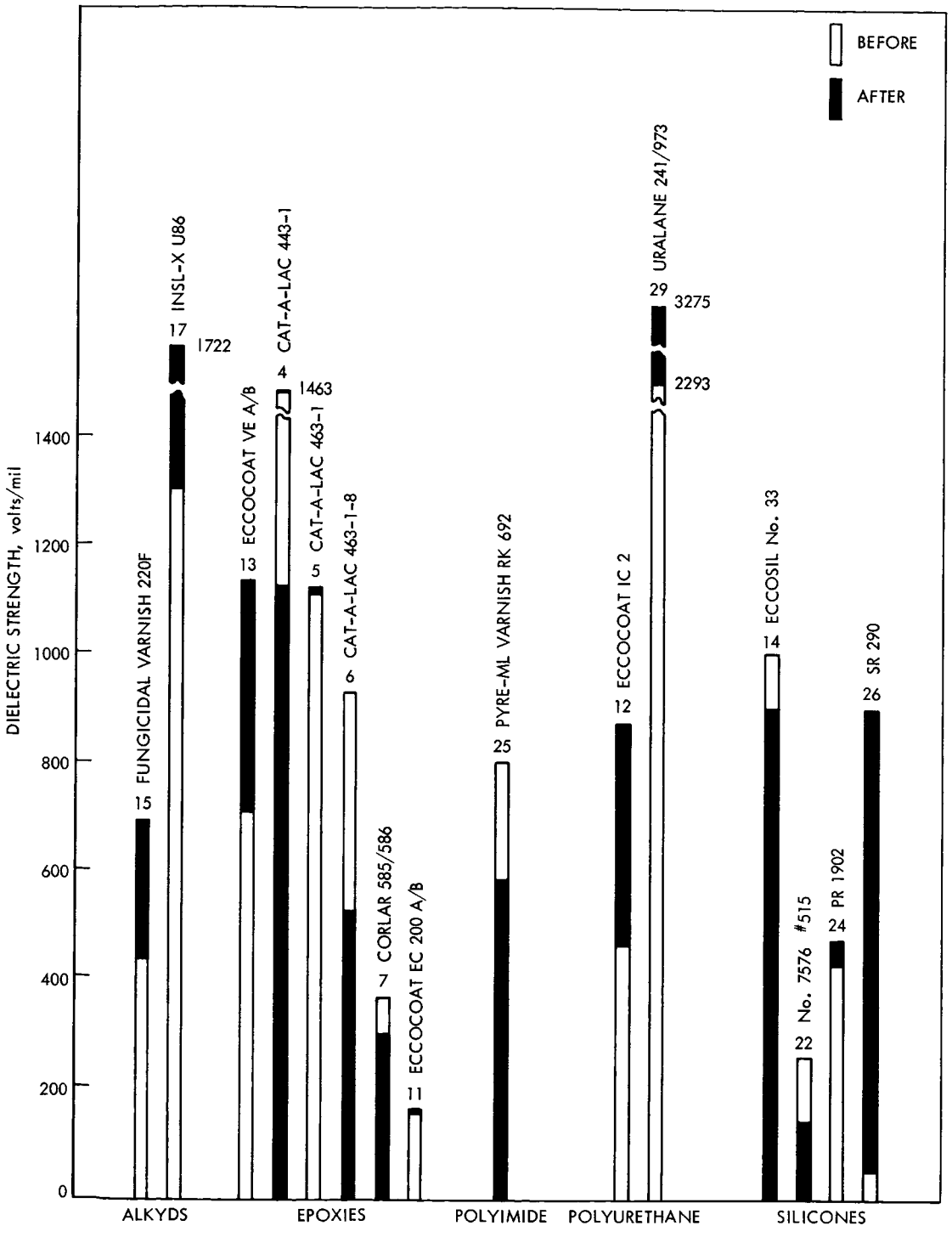

Fig. 2. Dielectric strength at room temperature of coatings before and after thermal exposure (3 cycles, 40 hr each at 300°F in nitrogen)

Butyls, fluorocarbons, fluorosilicones, neoprene, nitrile, and silicone were the base materials used in the type of elastomers tested. Such carbon-filled products as the butyls, neoprenes, and the nitriles were not subject to electrical criteria because they would not be used for insulation.

The elastomers were rated:

1. C where, after thermal exposure,
   a. They retained 80% or more of their original tensile strength,
   b. They retained 80% or more of their original percent elongation,
   c. Hardness change was less than 6 units,
   d. Weight loss was less than 1%,
   e. Electrical criteria were met.

2. M where either the
   a. Tensile strength retained was 70 to 80%,
   b. Elongation retained was 70 to 80%,
   c. Hardness change was more than 6 but less than 10 units,
   d. Weight loss was 1 to 4%,
   e. Electrical properties were borderline.

3. NC where either the
   a. Tensile strength retained was below 70%,
   b. Elongation retained was below 70%,
   c. Hardness change was more than 10 units,
   d. Weight loss was more than 4%,
   e. Failed any one of the electrical criteria.

The percent retention of tensile strength and elongation, and the change in hardness are given in Table 7. Graphical presentations of the mechanical properties are made in Fig. 3 and 4.

It can be seen from these figures and Tables 6 and 7 that none of the butyl-based products could be rated C. Although B-318-7/70 and Butyl 805-70 passed the compatibility criteria with respect to mechanical properties, weight losses exceeded 1%. Hadbar XB800-71 hardened with a considerable loss in elasticity; it was, therefore, rated NC along with Rubber 1814, which retained only 52% of its original tensile strength. SR 613-75 was rated M because it lost more than 1% in weight. As with adhesives, some of the butyl-based rubbers could have been advanced to a C rating with cleaning prior to the test.

Table 7. Change in hardness and percent retention of mechanical properties of elastomeric products after thermal exposure[a]

Elastomer type	Product	Unit change in hardness	Tensile strength % retained	Elongation % retained
Butyls	B-318-7/70	−6	88	93
	Butyl rubber 805-70	+4	84	82
	Hadbar XB 800-71	+18	113	30
	Rubber 1814	−3	52	98
	SR 613-75	+0.3	80	126
Fluoro-silicones	Hadbar 1000/80	+2	99	83
	Hadbar 5000/50	+6	103	84
	L-308-80	−2	108	110
	L-449-6/60	−0.2	90	97
Fluoro-carbons	Viton B60	No change	77	73
	Viton B95	No change	82	84
	Viton 77-545	No change	81	85
Silicones	AMS 3195	+5	107	85
	Hadbar 4000/80	+3	97	67
	PMP 6035	−4	110	81
	PMP 6100	+4	95	84
	RC-5 Silicone	+3	99	89
	RTV 501	−11	68	109
	RTV 615 A/B	+6	120	86
	S-417-7	−2	57	53
	Silastic 1410	+2	115	90
	Silicone Rubber 1050-70	+2	100	81
	Silicone Sheet 391-5	+5	126	77
Neoprene	RC-5 No. 1852	+14	107	56
Nitrile	N-195-7/70	+15	101	63

[a]Three cycles of 40 hrs each at 300°F in a nitrogen atmosphere.

All of the fluorosilicone-based products retained 90% or more of their initial tensile strength, and more than 80% of their initial percent elongation. Changes in hardness were insignificant, and weight losses amounted to less than 1% in all cases. They were all rated C. Table 7 shows that the mechanical properties of a number of fluorosilicone-based products increased in value after thermal exposure; increases are indicated whenever numbers are greater than 100.

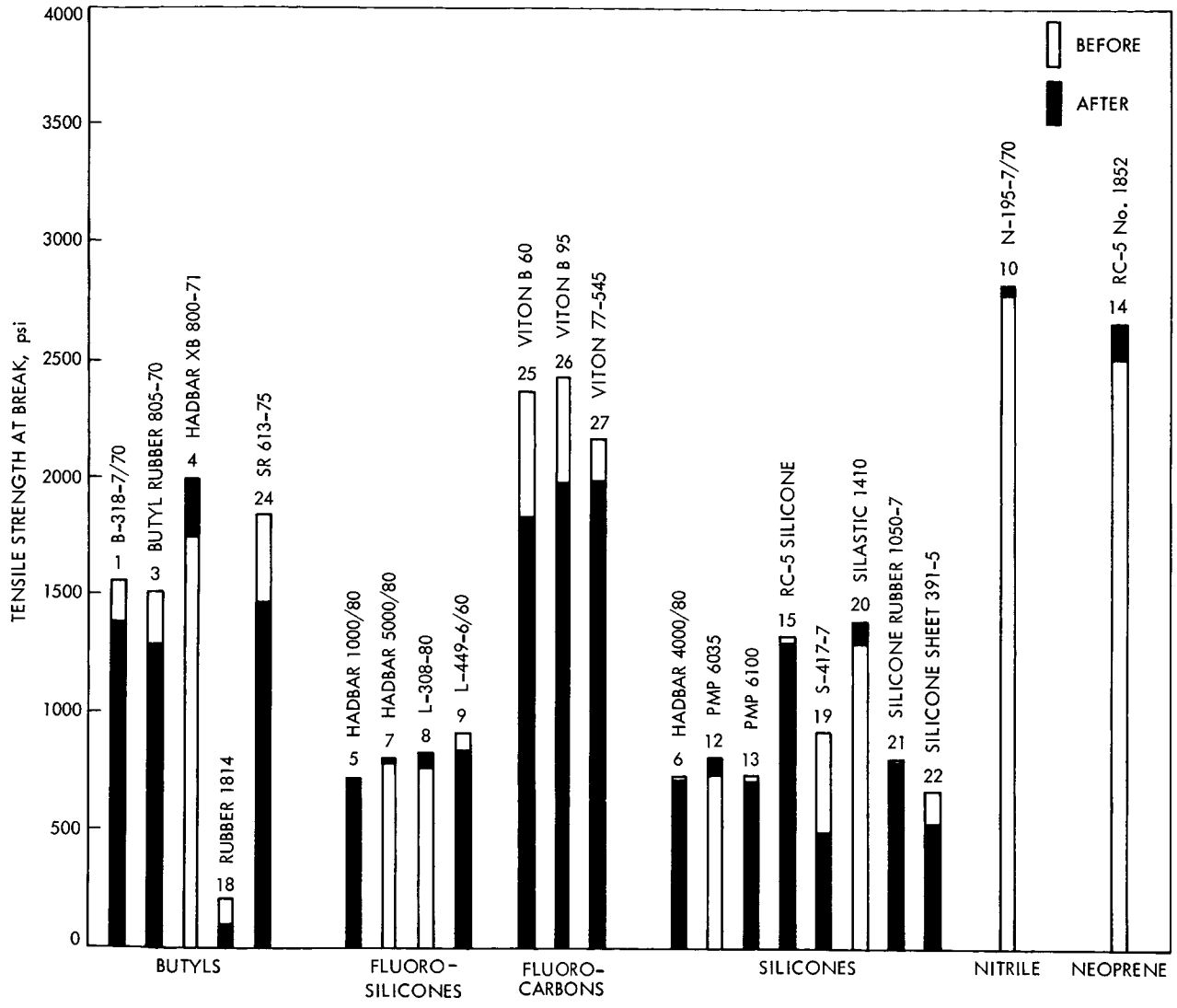

Fig. 3. Tensile strength of elastomeric products at room temperature before and after thermal exposure (3 cycles, 40 hr each a 300°F in nitrogen)

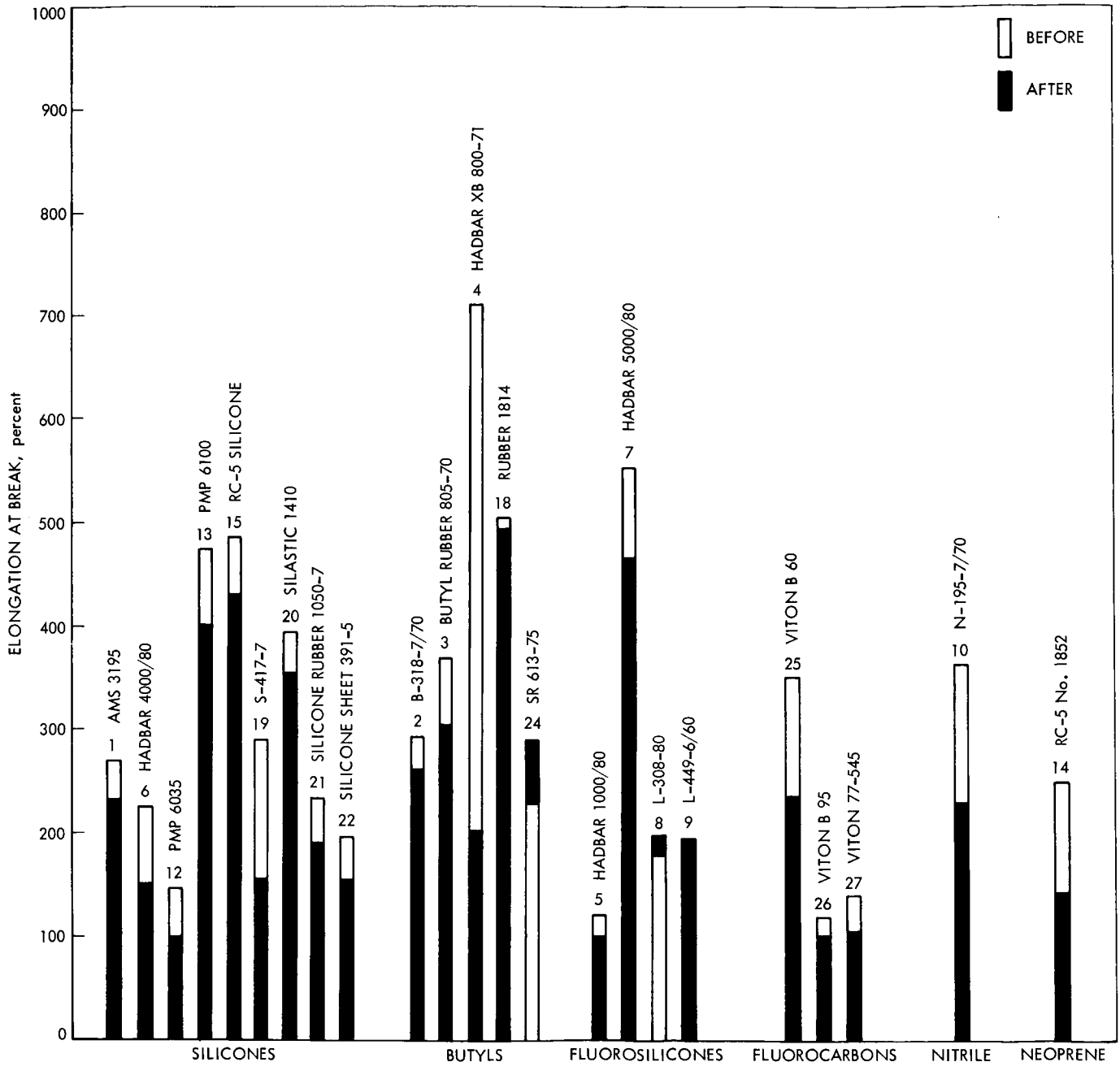

Fig. 4. Percent elongation of elastomeric products at room temperature before and after thermal exposure (3 cycles, 40 hr each at 300°F in nitrogen)

Table 8. Summary of test results for the thermal sterilization procedure[a] on encapsulants

No.	Commercial designation	Material type	Manufacturer	Mechanical properties: Hardness[b], Shore		Electrical properties: Volume resistivity[c], Ω - cm		Surface resistivity[c], Ω		Dielectric strength[c], mil		Physical and thermal properties: Specific gravity[d]		Weight loss[e], %	Volume change[f], %	Comments	Compatibility rating	References to manufacturer's literature
				Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure					
1	Apcofoam 1414-1.5/EPV	Polyurethane	Applied Plastics	—	—	—	—	—	—	—	—	—	—	—	—	Foamed in place; high weight and mechanical property losses—preliminary thermal exposure	NC	4M
2	Eccofoam FP/12-6	Polyurethane	Emerson Cuming	—	—	—	—	—	—	—	—	—	—	—	—	Same as above	NC	55M
3	Eccofoam S	Polyurethane	Emerson Cuming	—	—	—	—	—	—	—	—	—	—	—	—	Samples warped after preliminary thermal exposure	NC	56M
4	Eccosil 5000	RTV silicone foam	Emerson Cuming	56.3A	54A	1.65×10^{14}	1.16×10^{14}	6.11×10^{14}	3.61×10^{14}	66	74	0.5530	0.5587	1.951	3.81	Specific gravity figured from volume measurements; syntactic foam	M	47M
5	Epocast 202/9615	Epoxy	Furane Plastics	74D	82D	6.41×10^{14}	2.14×10^{15}	2.42×10^{15}	3.87×10^{15}	376	382	1.107	1.115	6.829	6.51	—	NC	66M, 68M
6	Epocast 212/951	Epoxy	Furane Plastics	84D	84.3D	2.69×10^{15}	2.29×10^{15}	3.61×10^{15}	2.58×10^{15}	395	392	1.168	1.168	0.575	0.77	—	C	67M
7	Hapex 1200A/Hardener 1210	Epoxy	Hastings Plastics	H61[g]	H57.5[g]	2.23×10^{15}	3.91×10^{14}	3.65×10^{14}	2.42×10^{14}	283	592	1.190	1.186	3.980	5.15	Discolors	M	80M
8	Hysol 4248	Epoxy	Hysol of Calif.	85.7D	86.7D	7.71×10^{14}	6.74×10^{14}	1.74×10^{15}	6.45×10^{14}	547	601	1.209	1.206	0.588	1.99	Slight darkening of color	C	83M
9	Number 5721 (Uralane)	Polyurethane	Furane Plastics	77.8A	66.0A	—	—	—	—	—	—	—	—	1.855	(expansion) 3.32	—	M	70M
10	Polycel 440R	Polyurethane	Polytron Co.	—	—	—	—	—	—	—	—	—	—	—	—	High loss in weight and mechanical properties after preliminary thermal exposure	NC	—
11	PR 1527A/B	Polyurethane	Prod. Research Co.	—	—	—	—	—	—	—	—	—	—	—	—	High loss in mechanical properties after preliminary thermal exposure	NC	112M
12	PR 1930-2/PR 1902	Silicone	Prod. Research Co.	50A	40A	5.81×10^{14}	9.11×10^{13}	3.61×10^{15}	1.95×10^{15}	585	575	1.445	1.451	1.180	0.84	—	M	113M
13	Proseal 777	Polyurethane	Coast Proseal	72A	13A	1.10×10^{10}	4.21×10^{9}	2.94×10^{11}	9.95×10^{10}	262	181	1.312	1.331	3.122	7.39	Excessive softening	NC	16M
14	RTV G-310	Silicone	Hysol of Calif.	29A	23A	9.83×10^{12}	7.66×10^{13}	3.45×10^{13}	1.52×10^{15}	562	580	1.310	1.330	2.056	6.10	—	NC	81M
15	RTV 11/Thermolite 12	Silicone	General Electric	51A	43A	2.02×10^{13}	1.02×10^{12}	1.04×10^{13}	1.09×10^{12}	247	213	1.186	1.189	1.201	6.63	Yellows	NC	71M
16	RTV 60/Thermolite 12	Silicone	General Electric	56.8A	55.7A	7.14×10^{12}	8.54×10^{13}	4.69×10^{13}	2.26×10^{15}	376	386	1.496	1.507	1.940	3.79	—	M	71M, 75M
17	RTV 881	Silicone	Dow Corning	38.3A	29.3A	9.41×10^{13}	2.71×10^{13}	4.85×10^{14}	3.82×10^{14}	394	433	1.120	1.122	1.236	3.88	—	M	27M
18	RTV 881 + Cab-O-Sil	Silicone	Dow Corning	41.7A	33.3A	7.90×10^{13}	6.36×10^{12}	1.80×10^{14}	1.34×10^{14}	357	389	1.091	1.097	1.364	1.57	—	M	27M
19	RTV 881 + DC 200	Silicone	Dow Corning	39A	28.2A	2.93×10^{14}	1.42×10^{13}	1.70×10^{15}	1.54×10^{14}	384	423	1.129	1.101	1.528	15.40	Excessive volume shrinkage	NC	27M
20	Scotchcast 260	Epoxy	3M Co.	84.3D	84.7D	1.63×10^{15}	3.20×10^{15}	5.42×10^{15}	5.93×10^{15}	549	437	1.372	1.372	0.931	1.70	—	C	101M
21	Scotchcast Resin No. 3	Epoxy/amine	3M Co.	80D	81D	9.68×10^{14}	3.67×10^{14}	5.73×10^{13}	3.14×10^{13}	992	932	1.096	1.088	10.140	5.83	Darkens; excessive weight loss	NC	93M
22	Scotchcast Resin 241A/B	Epoxy	3M Co.	41D	69D	2.94×10^{14}	1.17×10^{15}	2.06×10^{15}	5.26×10^{15}	394	382	1.457	1.464	0.000	1.16	Hardness increase due to additional cure	C	93M
23	Solithane 113/300	Polyurethane	Thiokol Chemical Co.	60.3A	52.5A	2.13×10^{14}	3.02×10^{14}	9.02×10^{15}	3.09×10^{15}	453	397	1.051	1.047	0.353	4.36	Slight darkening	M	128M
24	Solithane 113/300/328/T-12	Polyurethane	Thiokol Chemical Co.	60A	71.4A	9.50×10^{13}	1.30×10^{15}	2.10×10^{15}	4.90×10^{15}	383	422	1.066	1.057	2.488	2.86	Slight darkening	M	128M
25	Solithane 113/300/Calcofluor	Polyurethane	Thiokol Chemical Co.	60.2A	56.8A	1.50×10^{15}	5.60×10^{14}	3.10×10^{15}	2.70×10^{15}	442	395	1.051	1.049	0.346	3.87	Slight darkening	M	128M
26	Stycast 1090/9	Epoxy/amine	Emerson Cuming	77.3D	74D	1.34×10^{14}	7.39×10^{14}	1.62×10^{14}	2.47×10^{14}	334	352	0.844	0.840	0.000	1.82	Syntactic foam	C	49M, 57M
27	Stycast 1090/11	Epoxy/amine	Emerson Cuming	76D	70D	3.40×10^{13}	4.65×10^{14}	3.82×10^{14}	5.78×10^{14}	177	163	0.823	0.820	0.666	7.60	Syntactic foam	NC	49M, 57M
28	Stycast 1264A/B	Epoxy	Emerson Cuming	79.9D	81.7D	3.65×10^{15}	3.71×10^{15}	2.88×10^{15}	2.93×10^{15}	385	398	1.150	1.152	3.553	4.67	Darkens	M	48M
29	Stycast 2651/11	Epoxy/amine	Emerson Cuming	H76.5[g]	H76.9[g]	6.97×10^{14}	1.24×10^{15}	7.73×10^{14}	2.82×10^{14}	496	533	1.602	1.568	0.852	5.18	Darkens	M	58M
30	Stycast 2741/15	Epoxy	Emerson Cuming	62D	72D	8.95×10^{13}	4.90×10^{14}	1.11×10^{13}	2.73×10^{15}	391	399	1.275	1.280	4.284	7.17	—	NC	59M
31	Stycast 2850 GT/9	Epoxy/amine	Emerson Cuming	91D	90D	2.38×10^{15}	4.66×10^{15}	4.64×10^{14}	1.03×10^{15}	330	341	2.288	2.272	0.401	7.72	Darkens	NC	60M
32	Stycast 3050/9	Epoxy/amine	Emerson Cuming	H59.7[g]	H59.2[g]	5.94×10^{14}	6.27×10^{14}	3.25×10^{14}	2.73×10^{14}	279	516	1.583	1.588	1.187	5.49	—	M	61M
33	Sylgard 182	Silicone	Dow Corning	50A	52A	1.15×10^{14}	1.65×10^{15}	5.16×10^{14}	9.79×10^{14}	330	318	1.017	1.032	0.855	3.08	Slight yellowing	C	18M, 125M
34	Sylgard 184	Silicone	Dow Corning	51A	46A	3.32×10^{15}	2.54×10^{15}	4.25×10^{15}	6.45×10^{15}	360	390	1.040	1.042	1.039	1.32	Slight yellowing	C	18M, 28M

[a]Three cycles of 40 hr each at 300°F in a nitrogen atmosphere.
[b]ASTM D676-59T.
[c]ASTM D257.
[d]FTMS #406, Method 5011.
[e]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.
[f]Volume measurements determined using Ames Micrometer Dial Gage, accuracy ±0.1 mil.
[g]Rockwell scale.

One of the three fluorocarbon-based elastomeric products, Viton B-60 (No. 25, Table 6), was rated M because of loss in tensile strength and elongation. The other two (No. 26 and 27) were rated C. It is significant that all three fluorocarbon-based products did not suffer a change in hardness.

Of the eleven silicone-based products, two, RTV 501 (No. 16) and S-417-7 (No. 19), were rated NC, RTV 501 on the basis of a large change in hardness and tensile strength, and S-417-7 because of considerable loss in tensile strength and elongation (Table 7 and Fig. 2 and 3). The other silicone products met the criteria for compatibility.

The two neoprene- and the two nitrile-based products tested were all rated NC. One of the neoprene products, PMP 42011 AE (No. 11, Table 6) was actually a blend with SBR, and failed the weight loss and hardness criteria during the preliminary screening (Table A-3, Appendix A). The other, RC-5 No. 1852 (No. 14, Table 6), suffered high loss in weight, hardened excessively, and retained less than 60% of its initial elongation (Table 7 and Fig. 3). One of the nitrile-based products, SR 349-70 (No. 23, Table 6) was rated NC after the preliminary screening tests (Table A-3, Appendix A); the other, N-195-7/70 (No. 10, Table 6) hardened and lost elasticity (Table 7 and Fig. 4).

Results indicate that the fluorosilicone, silicone, and fluorocarbon products are least affected by heat. The butyls are more sensitive to thermal exposure, and the neoprenes and nitriles (Buna N) are the most sensitive. The order of resistance to thermal exposure would be as follows:

fluorosilicones > silicones > fluorocarbons > butyls > nitrile > neoprene.

There were no significant changes in the electrical properties of those elastomers that would be likely candidates for insulation.

The elastomers are used in spacecraft as gaskets, seals, and grommets.

About 50% of the elastomers tested were rated C.

4. Encapsulants

The term "encapsulant" is used in this discussion to define a class of compounds that serve special needs in packaging, such as potting, embedment, impregnation, conformal coating, and sealing.[2] The term as used here also means a castable material, liquid in state, that can be poured into a mold, pot, or cavity, or applied to a surface and cured in place to the solid state. The encapsulants tested had base compositions of epoxy, polyurethane, or silicone.

A summary of thermal exposure test results for encapsulants is given in Table 8. Detailed data for the preliminary screening program are found in Table A-4 of Appendix A, and detailed test results are provided in Table B-4 of Appendix B.

Weight loss, volume shrinkage, hardness and electrical properties were used to rate compatibility. The encapsulants were rated:

1. C where, after thermal exposure,
   a. Weight loss was less than 1%,
   b. Volume shrinkage was less than 4%,
   c. Drop in hardness was less than 10 units,
   d. Electrical criteria were met.
2. M where either the
   a. Weight loss was 1 to 4%,
   b. Volume shrinkage was 4 to 6%,
   c. Drop in hardness was more than 10 but less than 15 units,
   d. Electrical properties were borderline.
3. NC where either the
   a. Weight loss was more than 4%,
   b. Volume shrinkage was more than 6%,
   c. Drop in hardness was more than 15 units,
   d. Failed any of the electrical criteria.

Using these criteria, four of the epoxy-based products in Table 8 (No. 5, 21, 30, and 31) were rated NC with regard to weight loss or volume change. Four (No. 7, 28, 29, and 32) were considered M, again because of weight loss or volume change. The remaining six (No. 6, 8, 20, 22, 26, and 27) met the compatibility criteria.

[2]Definitions and distinctions between these terms are given in *Glossary for Packaging and Cabling*, F. L. Lane, JPL Interoffice Memorandum, November 1, 1965.

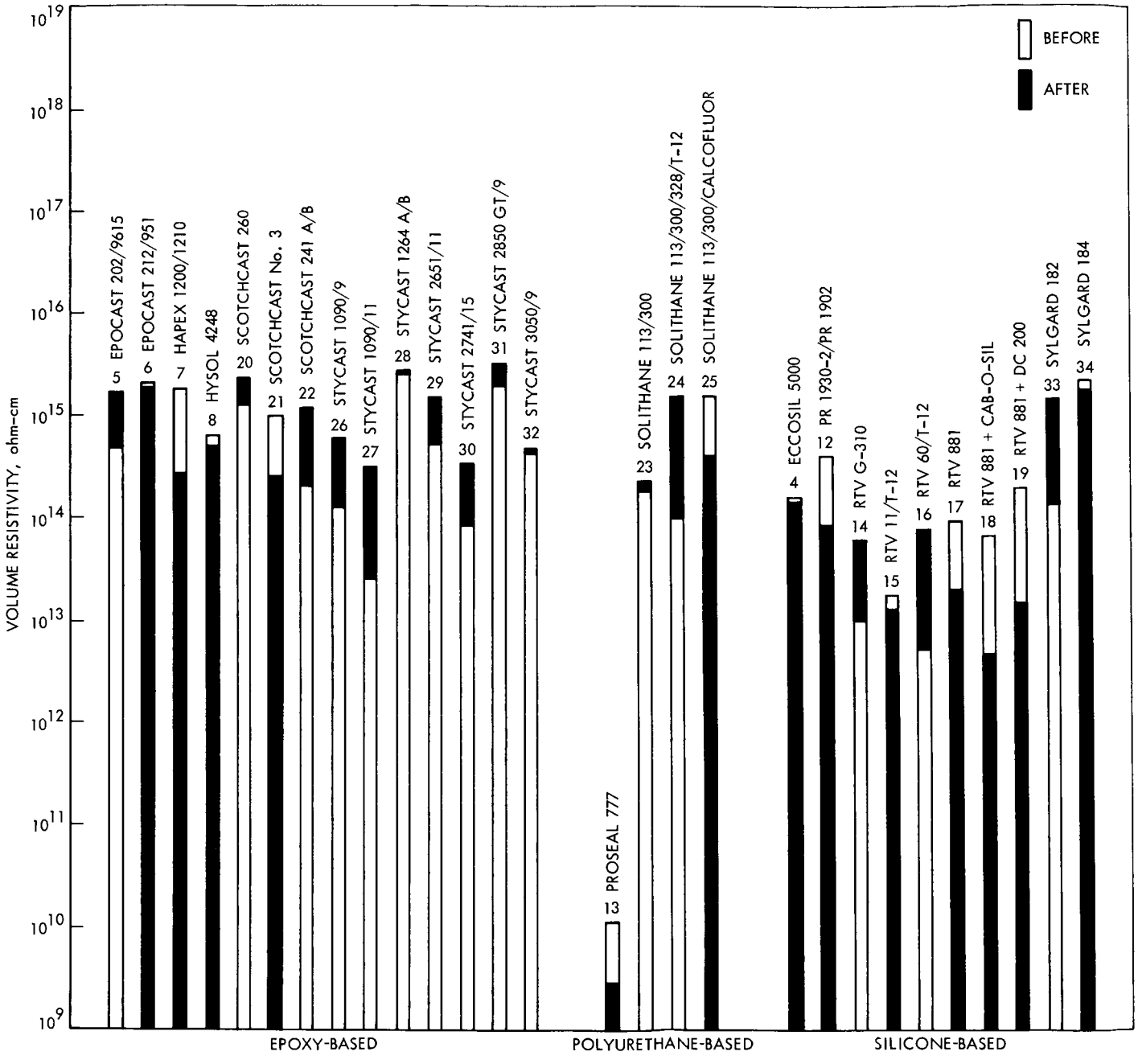

Fig. 5. Volume resistivities of encapsulants at room temperature before and after thermal exposure (3 cycles, 40 hr each at 300°F in nitrogen)

None of the ten polyurethane-based products could be rated C, as expected from the known thermal stability of the urethane bond (Ref. 7). All the foam products (No. 1, 2, 3, and 10) failed the preliminary tests. High losses in weight and mechanical properties indicated degradation of these materials. Also failing the preliminary tests for weight and mechanical property measurements was No. 11. Excessive softening, volume shrinkage and drop in electrical properties indicated extensive degradation of No. 13. The remaining polyurethane products (No. 9, 23, 24, and 25) were rated M, with regard to weight loss or volume shrinkage.

Three out of ten silicone-based encapsulants (No. 14, 15, and 19) were rated NC because of high volume shrinkage, and four were considered marginal (No. 4, 16, 17, and 18) because weight losses amounted to more than 1%. Three (No. 12, 33, and 34) were rated C.

The volume resistivities of the encapsulants before and after thermal exposure are shown graphically in Fig. 5. Note that values increased in many instances; this was probably caused by removal of volatile polar ingredients, or further curing of the encapsulant at the higher temperature (Ref. 12 to 14). The dielectric strength usually increased with increase in volume resistivity (Fig. 6). The majority of the encapsulants easily met the criteria for electrical properties. The effects of thermal exposure on other properties of encapsulants was, however, more pronounced. As a result, only 20% of the those tested were rated compatible.

5. Films

A summary of thermal exposure test results for films is given in Table 9. Detailed data for the preliminary screening program are found in Table A-5 of Appendix A, and detailed test results are provided in Table B-5 of Appendix B.

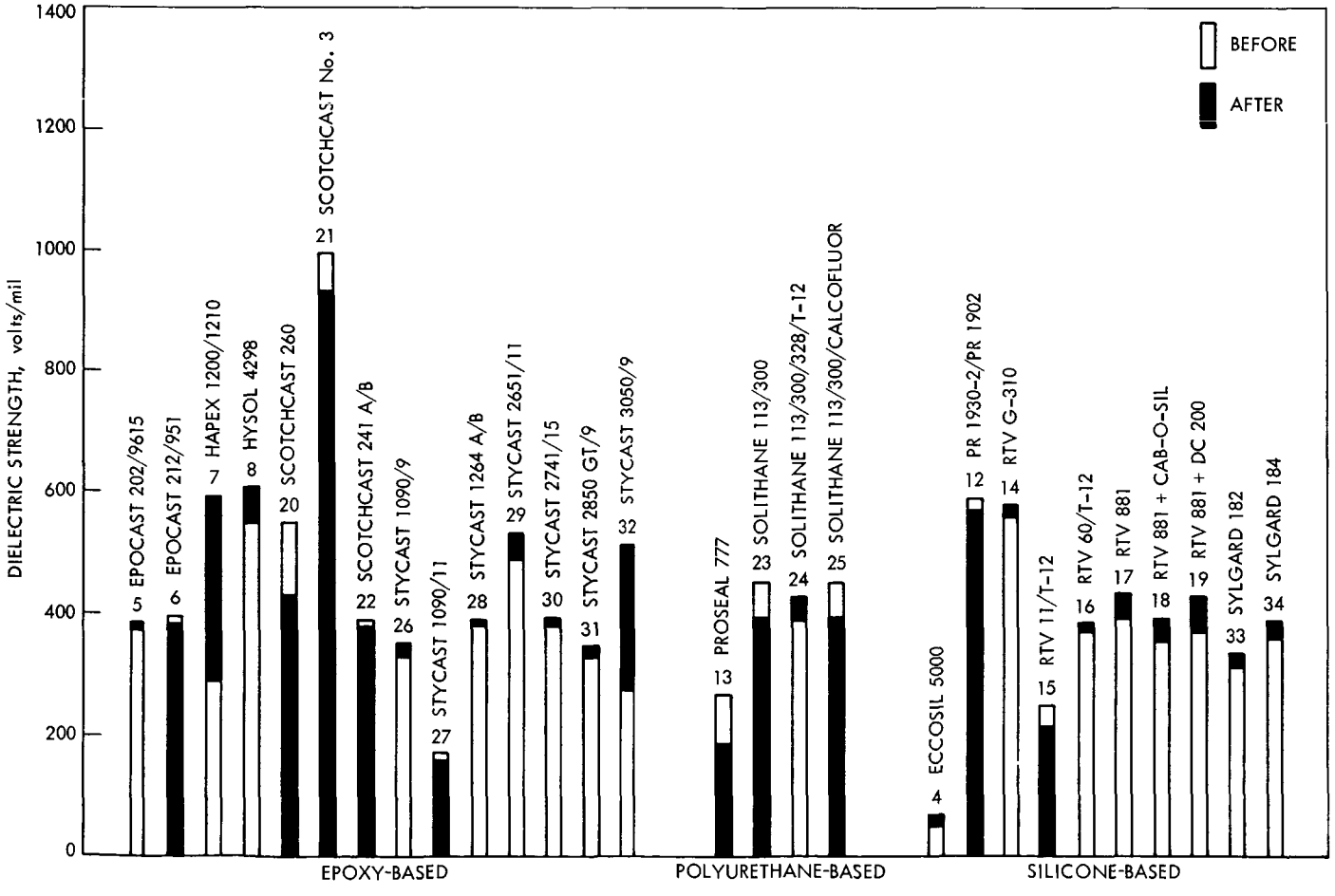

Fig. 6. Dielectric strength of encapsulants at room temperature before and after thermal exposure (3 cycles, 40 hr each at 300°F in nitrogen)

Tensile strength, elongation, tear strength, weight loss and electrical properties were used to rate the films as follows:

1. C where, after thermal exposure,
   a. Tensile strength, tear strength, and elongation retained were more than 80%,
   b. Weight loss was less than 1%,
   c. Electrical criteria were met.
2. M where either the
   a. Mechanical properties retained were 70 to 80%,
   b. Weight losses were 1 to 4%,
   c. Electrical properties were borderline.
3. NC where either the
   a. Mechanical properties retained were below 70%,
   b. Weight losses were more than 4%,
   c. Failed any one of the electrical criteria.

Six of the eight films in Table 9 were polyesters (Mylar), three of which (No. 3, 5, and 7) were rated NC because of loss in mechanical properties (Table 10 and Fig. 7 to 9). One (No. 2, Table 9) was rated M because of loss in tensile strength, and the remaining two (No. 4 and 6) were given a C rating. Number 6 was a heat shrinkable polyester film, and control tests were performed on preshrunk samples. The tensile and tear strength of this material increased after thermal exposure. The same type of change occurred with the Tedlar poly(vinyl fluoride) film (No. 8), which was rated C. The polyimide (No. 1) suffered loss in elongation after exposure, which was unexpected; it was rated M.

The films tested showed little loss in weight, except Mylar 22 (No. 7), which lost over 6% of its original weight. There were no significant changes in their electrical properties after thermal exposure (Fig. 10).

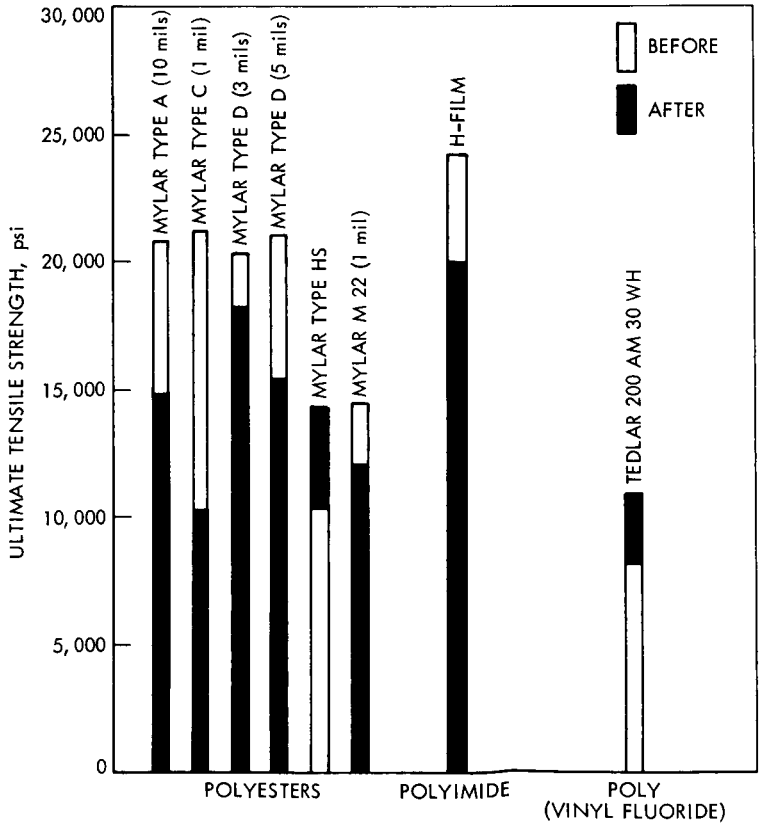

Fig. 7. Tensile strength of films at room temperature before and after thermal exposure (3 cycles, 40 hr each at 300°F in nitrogen)

Table 9. Summary of test results for the thermal sterilization procedure[a] on films

No.	Commercial designation	Material type	Manufacturer	Mechanical properties						Electrical properties						Physical properties	Comments	Compatibility rating	References to manufacturer's literature
				Tensile strength[b], psi		Elongation[b], %		Tear strength[c], lb/in.		Volume resistivity[d], Ω-cm		Surface resistivity[d], Ω		Dielectric strength[d], mil		Weight loss[e], %			
				Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure				
1	H-Film (Kapton)	Polyimide	Du Pont	24153	19811	70	31	3259	3118	1.20×10^{16}	8.59×10^{16}	1.28×10^{15}	4.49×10^{14}	3884	3896	0.624	—	M	29M, 30M
2	Mylar Type A (10 mils)	Polyester	Du Pont	20659	14749	102	204	3396	3057	2.78×10^{16}	3.19×10^{16}	9.62×10^{14}	5.10×10^{14}	2333	2550	0.158	Gets bluish	M	32M, 34M, 36M
3	Mylar Type C (1 mil)	Polyester	Du Pont	21166	10106	23	3	3978	3750	4.81×10^{16}	5.63×10^{16}	1.39×10^{15}	5.57×10^{14}	5033	4813	0.183	—	NC	32M, 34M, 36M
4	Mylar Type D (3 mils)	Polyester	Du Pont	20255	18110	72	65	4038	3166	4.65×10^{16}	4.31×10^{16}	1.80×10^{15}	6.29×10^{14}	3800	3120	0.077	—	C	32M, 34M, 36M
5	Mylar Type D (5 mils)	Polyester	Du Pont	20980	15309	98	43	3547	3219	9.26×10^{16}	3.34×10^{16}	1.04×10^{15}	3.82×10^{14}	3100	2580	0.166	—	NC	32M, 34M, 36M
6	Mylar Type HS	Polyester	Du Pont	10300	14200	12	11	1910	2410	8.90×10^{15}	8.20×10^{15}	4.30×10^{15}	3.70×10^{15}	4007	4193	0.000	Heat shrinkable; control tests performed on preshrunk material	C	32M, 34M, 36M
7	Mylar M22 (1 mil)	Polyester	Du Pont	14351	11978	43	10	2972	2713	1.35×10^{16}	1.65×10^{16}	1.04×10^{15}	4.39×10^{14}	4410	4110	6.058	Severe darkening; high weight loss	NC	32M, 34M, 36M
8	Tedlar 200 AM 30 WH	Poly(vinyl fluoride)	Du Pont	8022	10744	82	104	1907	1928	1.01×10^{15}	1.64×10^{15}	1.13×10^{15}	3.09×10^{14}	2186	2137	0.106	—	C	33M, 35M, 37M, 38M
9	SRD 5905	Polyester/silicone	3M Co.	5118	4882	29	19	737	580	5.90×10^{14}	7.30×10^{13}	2.50×10^{15}	1.80×10^{15}	418	450	0.230	—	M	97M

[a]Three cycles of 40 hr each at 300°F in a nitrogen atmosphere.
[b]ASTM D882-61T.
[c]ASTM D624-54.
[d]ASTM D257.
[e]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

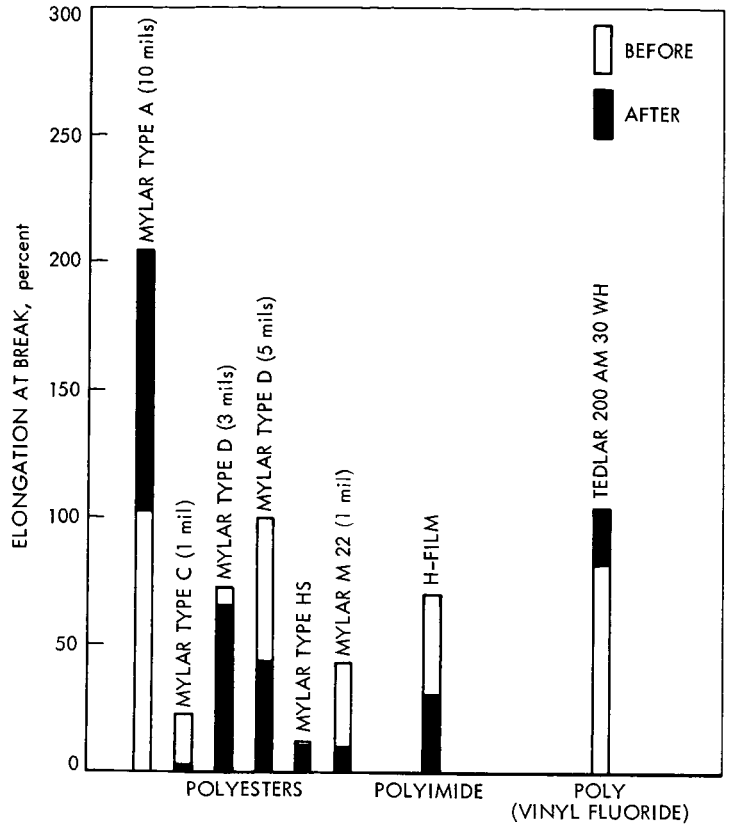

Fig. 8. Percent elongation of films at room temperature before and after thermal exposure (3 cycles, 40 hr each at 300°F in nitrogen)

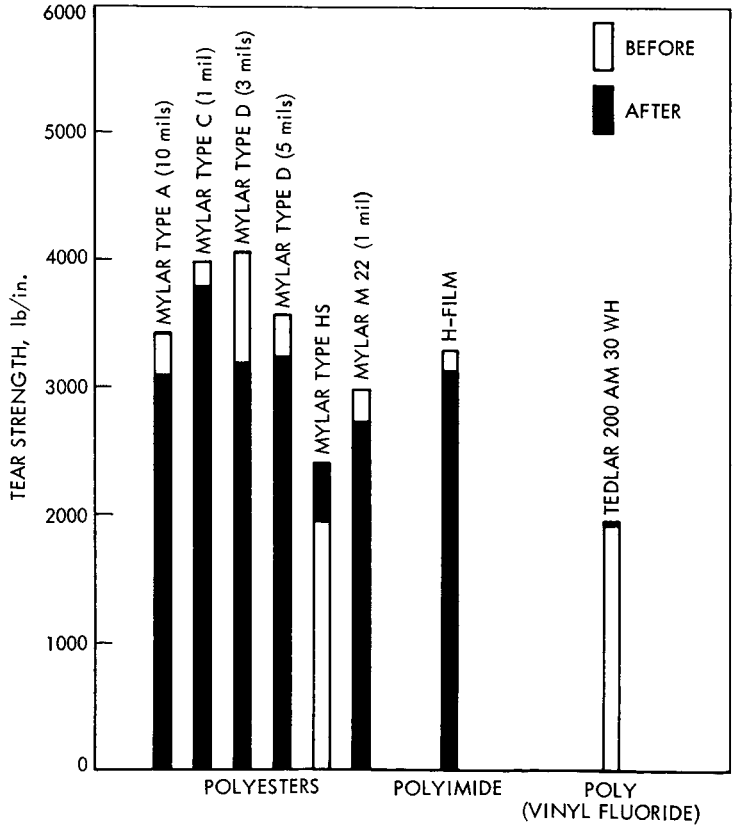

Fig. 9. Tear strength of films at room temperature before and after thermal exposure (3 cycles, 40 hr each at 300°F in nitrogen)

Table 10. Percent retention of mechanical properties of films after thermal exposure[a]

Material type	Product	Tensile strength % retained	Elongation % retained	Tear strength % retained
Polyester	Mylar Type A (10 mils)	71	200	96
	Mylar Type C (1 mil)	48	10	94
	Mylar Type D (3 mils)	90	90	79
	Mylar Type D (5 mils)	73	55	91
	Mylar Type HS	138	92	126
	Mylar M22 (1 mil)	84	22	90
	SRD 5905[b]	95	66	79
Polyimide	H-film (Kapton)	83	53	96
Poly(vinyl fluoride)	Tedlar 200 AM 30 WH	133	127	101

[a]Three cycles of 40 hrs each at 300°F in a nitrogen atmosphere.
[b]Used as thermal shield.

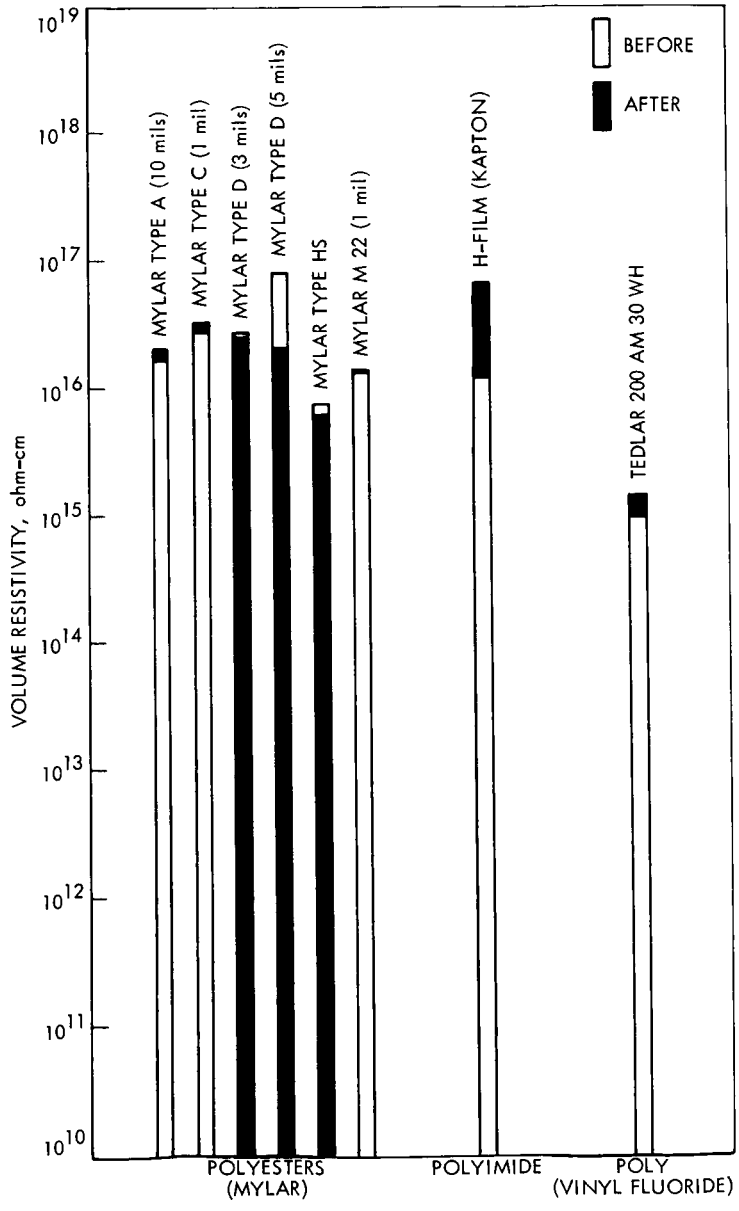

Fig. 10. Volume resistivities at room temperature of films before and after thermal exposure (3 cycles, 40 hr each at 300°F in nitrogen)

Less than 30% of the film products were given a C rating.

Tested as a film was SRD 5905 (No. 9), which is used as a thermal shield. Loss in elongation (Table 10) was the reason for rating it M.

6. Lubricants

A summary of thermal exposure test results for lubricants is given in Table 11. Detailed data for the preliminary screening program are found in Table A-6 of Appendix A, and detailed test results are provided in Table B-6 of Appendix B.

The lubricants tested included both oils (fluids) and greases (semi-solids). Viscosity and weight loss measurements were applied to the former, cone penetration and weight loss determinations to the latter. Material types included silicones, esters, and a hydrocarbon. The lubricants were rated:

1. C where, after thermal exposure,
   a. Viscosity or cone penetration changes were less than 5 units,
   b. Weight losses were less than 1%.
2. M where either the
   a. Viscosity or cone penetration changes were 5 to 10 units,
   b. Weight losses were 1 to 2%.
3. NC where either the
   a. Viscosity or cone penetration changes were more than 10 units,
   b. Weight losses were more than 2%.

The high weight losses of the ester-type lubricants (No. 1 and 6, Table 11) makes them incompatible with thermal exposure. In some cases, the vapor pressure at room temperatures was high enough to warrant an NC rating, but they were subjected to tests for purposes of reference. The hydrocarbon grease, Apiezone T, melted below the exposure temperature, making it unsuitable as a grease. The four silicone lubricants were rated C.

7. Reinforced Plastics

A summary of thermal exposure test results for reinforced plastics is given in Table 12. Detailed data for the preliminary screening program are found in Table A-7 of Appendix A, and detailed test results are provided in Table B-7 of Appendix B.

Hardness, tensile strength, weight loss and electrical properties were used for rating this group. The reinforced plastics were rated:

1. C where, after exposure,
   a. Tensile strength retained was more than 80%,
   b. Hardness change was less than 8 units,
   c. Weight loss was less than 1%,
   d. Electrical criteria were met.
2. M where either the
   a. Tensile strength retained was 70 to 80%,
   b. Hardness change was 8 to 12 units,
   c. Weight loss was 1 to 4%,
   d. Electrical properties were borderline.
3. NC where either the
   a. Tensile strength retained was below 70%,
   b. Hardness change was more than 12 units,
   c. Weight loss was more than 4%,
   d. Failed any one of the electrical criteria.

Material types included diallyl phthalates and epoxies, all of which were reinforced with glass fiber or glass cloth, and phenolics, three of which were also reinforced with glass fiber or glass cloth. Two phenolics were reinforced with linen cloth and one by nylon fabric.

Hardness changes and percent tensile strength retained are given in Table 13. Figure 11 is a graphical representation of the tensile strength before and after thermal exposure. It can be seen from Table 13 and Fig. 11 that, after thermal exposure, the plastic products tested retained at least 90% of their initial tensile strength, and many increased in tensile strength. The hardness of the reinforced products increased in all cases but one (No. 15, Table 12) where there was a negligible decrease. The mechanical properties of all reinforced plastics were compatible with thermal exposure, with the exception of Micarta LE-221 (No. 14), which showed more than 8 units change in hardness.

Table 11. Summary of test results for the thermal sterilization procedure[a] on lubricants (oils and greases)

No.	Commercial designation	Material type	Manufacturer	Viscosity[b], cp		Cone penetration[c], worked		Weight loss[d], %	Comments	Compatibility rating	References to manufacturer's literature
				Control	After thermal exposure	Control	After thermal exposure				
1	Aeroshell Grease 7A	Diester/Li soap, lubricant	Shell Chemical	—	—	275	295	20.500	Slight darkening of color	NC	122M
2	Apiezon Grease T	Hydrocarbon	Carl Hermann Ass.	—	—	—	—	—	Melts at 250°F	NC	7M
3	DC-5 Grease	Phenyl methyl siloxane, grease	Dow Corning	—	—	232	232	0.210	Turns pinkish	C	23M
4	DC-11 Grease	Silicone, grease	Dow Corning	—	—	227	227	0.936	Slight darkening of color	C	25M
5	DC-200, 350cs	Poly (dimethylsiloxane)	Dow Corning	414	410	—	—	0.183	No observable color change	C	22M, 24M
6	Diallyl Phthalate	Phthalate ester	Union Carbide	—	—	—	—	99.400	Evaporates at 300°F	NC	—
7	Versilube F-50	Silicone	G. E. Silicone Div.	92	90	—	—	0.017	No observable color change	C	74M

[a]Three cycles of 40 hr each at 300°F in a nitrogen atmosphere.

[b]ASTM D2196-63T.

[c]ASTM D217-60T.

[d]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

Table 12. Summary of test results for the thermal sterilization procedure[a] on reinforced plastics

No.	Commercial designation	Material type	Manufacturer	Mechanical properties						Electrical properties						Thermal property	Comments	Compatibility rating	References to manufacturer's literature
				Hardness[b], Rockwell		Tensile strength[c], psi		Elongation[c], %		Volume resistivity[d], Ω-cm		Surface resistivity[d], Ω		Dielectric strength[d], v/mil		Weight[e] loss, %			
				Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure				
1	Diall FS-4	Diallyl phthalate/glass	Mesa Plastics	E 89.3	E 94.8	3450	3610	0.63	0.84	1.49×10^{15}	2.66×10^{15}	1.65×10^{14}	2.47×10^{15}	382	390	0.582	—	C	88M, 89M
2	Diall FS-10	Diallyl phthalate/glass	Mesa Plastics	H 92.3	H 99.2	5698	6260	1.00	0.93	1.15×10^{15}	4.38×10^{15}	1.08×10^{15}	4.13×10^{15}	381	385	0.820	Darkens	C	88M, 89M
3	Diall 52-20-30	Diallyl phthalate/glass	Mesa Plastics	E 79.5	E 83.0	4890	5210	0.76	0.85	9.09×10^{14}	3.95×10^{15}	9.78×10^{14}	4.38×10^{15}	343	353	0.731	—	C	88M, 89M
4	EG 758-T	Epoxy/glass/Cu	Mica Corp.	E 93.0	E 94.2	62650	57332	4.1	3.4	2.20×10^{14}	3.70×10^{15}	Surface conductive		—	—	0.010	Copper makes surface conductive	C	92M
5	Fiberglass 91 LD	Phenolic/glass	Amer. Reinforced Plastics	B 77.7	B 82.5	40525	38800	3.0	2.3	1.48×10^{13}	1.12×10^{14}	7.72×10^{12}	4.64×10^{13}	568	748	1.148	—	C	2M, 3M
6	Laminate Type EG 752	Epoxy/glass	Mica Corp.	H 95.5	H 98.5	31925	35250	2.0	2.1	6.63×10^{14}	1.77×10^{15}	1.91×10^{14}	1.10×10^{15}	615	612	0.255	—	C	92M
7	Laminate Grade H 5834	Phenolic/glass	Westinghouse	B 72.3	B 78.6	32025	34050	3.4	3.6	4.88×10^{13}	1.19×10^{15}	1.75×10^{14}	1.21×10^{15}	271	271	1.257	—	M	130M
8	Laminate NS	Phenolic/nylon	Plastic Center	H 79.3	H 90.3	7048	7100	10.8	9.2	3.40×10^{13}	1.70×10^{15}	1.80×10^{14}	2.70×10^{15}	>382	>383	2.827	—	M	—
9	Laminate 500J	Epoxy/glass/Cu	Budd Co.	E 88.3	E 89.0	44330	45800	3.3	2.9	1.63×10^{14}	2.40×10^{14}	Surface conductive		—	—	0.007	Slight weight gain, probably due to oxidation of Cu surface	C	—
10	Micarta Grade 238	Phenolic/linen	Westinghouse	E 77.0	E 82.0	8703	8530	1.9	1.7	8.60×10^{12}	2.73×10^{14}	1.65×10^{13}	3.50×10^{14}	248	371	4.053	—	NC	130M
11	Micarta GX (H 17480)	Epoxy/glass	Westinghouse	E 91.8	E 92.3	63760	65650	6.1	6.1	1.50×10^{14}	2.46×10^{14}	1.39×10^{14}	2.52×10^{14}	>311	>316	0.374	—	C	130M
12	Micarta H-2497 (G-11)	Epoxy/glass	Westinghouse	F 90.3	F 93.2	45425	45700	4.1	3.7	1.92×10^{15}	2.96×10^{15}	8.61×10^{14}	2.37×10^{15}	388	367	0.147	—	C	130M
13	Micarta HY-180 (G-10)	Phenolic/glass	Westinghouse	F 73.5	F 77.0	64300	60550	—	—	8.34×10^{15}	9.90×10^{15}	2.11×10^{15}	2.57×10^{15}	>295	>292	0.149	Samples tubular; slight darkening	C	130M
14	Micarta LE-221	Phenolic/linen	Westinghouse	F 56.5	F 65.5	7972	7892	1.7	1.9	9.81×10^{14}	3.22×10^{12}	1.13×10^{13}	3.20×10^{14}	360	380	3.439	Darkens	M	130M
15	Micarta 8457 G-10	Epoxy/glass	Westinghouse	E 83.3	E 82.0	42925	42100	3.4	3.2	3.14×10^{15}	3.57×10^{15}	3.40×10^{15}	3.25×10^{15}	384	386	0.205	Slight darkening	C	130M
16	XP-206 Fiberglass	Epoxy/glass	3M Co.	Longitudinal:		67900	78500	6.5	5.0	1.44×10^{15}	1.87×10^{15}	2.17×10^{15}	1.96×10^{15}	424	333	0.135	Darkens	C	99M
				Transverse:		1930	3905	3.0	8.7										

[a]Three cycles of 40 hr each at 300°F in a nitrogen atmosphere.
[b]ASTM D785.
[c]ASTM D638-61T.
[d]ASTM D257.
[e]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

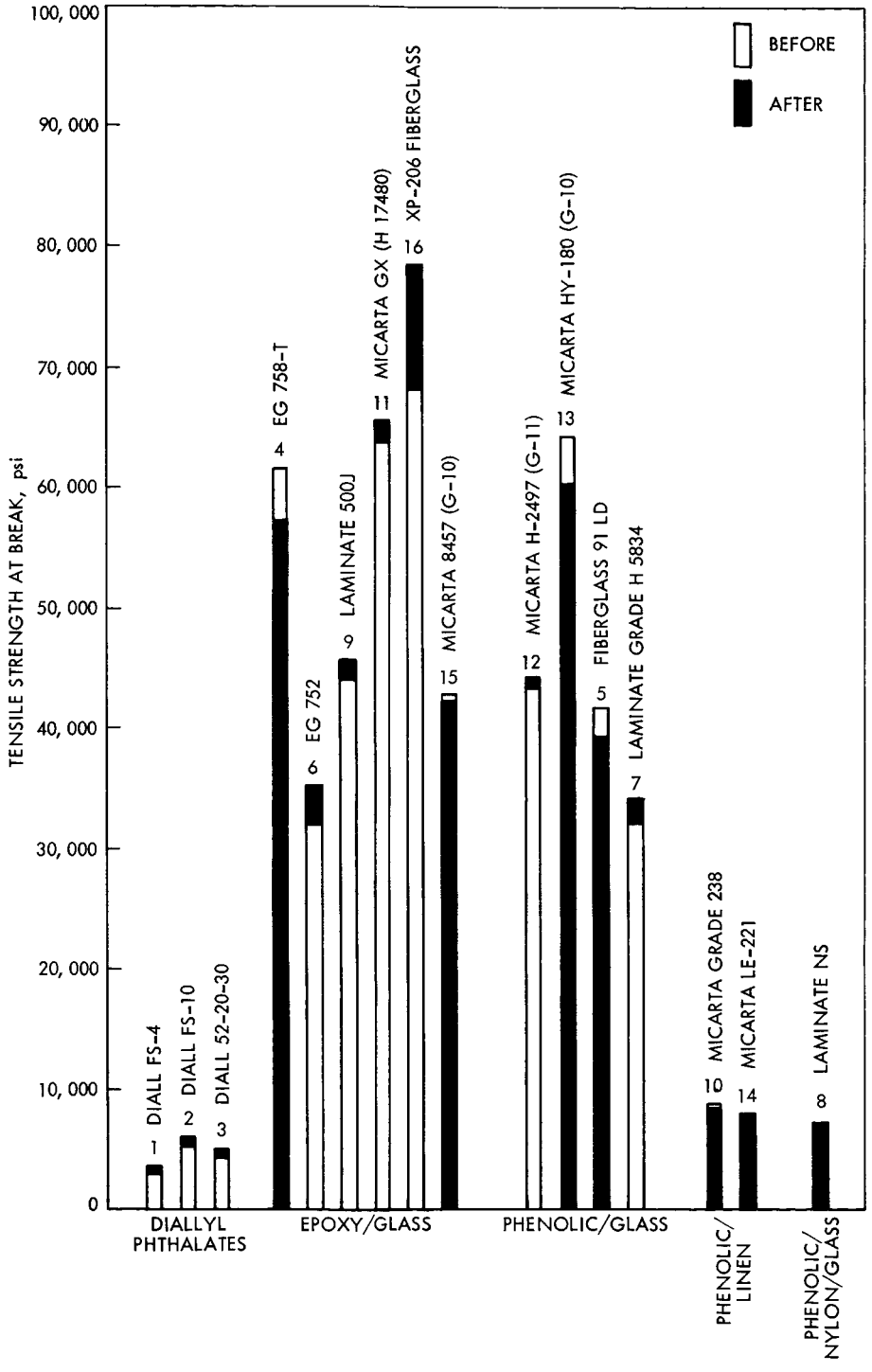

Fig. 11. Tensile strength of reinforced plastics at room temperature before and after thermal exposure (3 cycles, 40 hr each at 300°F in nitrogen)

Table 13. Change in hardness and percent retention of tensile strength of reinforced plastics after thermal exposure[a]

Material type	Product	Unit change in hardness	Tensile strength % retained
Diallyl phthalate/glass	Diall FS-4	+6	104
	Diall FS-10	+7	110
	Diall 52-20-30	+3	106
Epoxy/glass cloth	EG 758-T	+1	92
	EG 752	+3	110
	Laminate 500J	+1	103
	Micarta GX (H 17480)	+0.5	103
	Micarta H 2497 (G-11)	+3	100
	Micarta 8457 (G-10)	−1	98
	XP-206 Fiberglass		115
Phenolic/glass cloth	Fiberglass 91LD	+5	96
	Laminate Grade H 5834	+6	106
	Micarta HY-180 (G-10)	+3	94
Phenolic/linen cloth	Micarta Grade 238	+6	98
	Micarta LE-221	+11	99
Phenolic/nylon fabric	Laminate NS	+11	100

[a]Three cycles of 40 hrs each at 300°F in a nitrogen atmosphere.

With the exception of linen and nylon reinforced phenolics, all others showed less than 1% weight loss. The linen and nylon reinforced phenolics were rated M or NC depending upon the amount of weight lost.

The electrical properties of the reinforced products showed gains in most instances (Fig. 12). In a few cases (Fig. 13, and No. 10, 12, and 16, Table 12), the decrease in dielectric strength was not sufficient to change the compatibility rating. Two plastics (No. 4 and 9) were copper clad and, therefore, their surface resistivities and dielectric strengths could not be measured. Moreover, since the cladding may well have prevented weight loss, and thus changed the course of a degradation, these plastics may well have a different rating if extensive amounts of cladding are removed for their end-use application.

The reinforced plastics tested showed satisfactory resistance to thermal exposure. Seventy-five percent were rated compatible.

8. Tapes

A summary of thermal exposure test results for tapes is given in Table 14. Detailed data for the preliminary screening program are found in Table A-8 of Appendix A, and detailed test results are provided in Table B-8 of Appendix B.

For rating, peel adhesion data, weight loss and electrical properties were used. Tapes were rated:

1. C where, after exposure,
   a. Peel adhesion retained was 80% or more,
   b. Weight loss was less than 1%,
   c. Electrical criteria were met.
2. M where either the
   a. Peel adhesion retained was 70 to 80%,
   b. Weight loss was 1 to 4%,
   c. Electrical properties were borderline.
3. NC where either the
   a. Retained peel adhesion was below 70%,
   b. Weight loss was more than 4%,
   c. Failed any one of the electrical criteria.

Four of the five tapes tested were made of glass fabric, and one of Mylar (polyester). The adhesives used with glass fabric tapes were silicones and epoxies. The peel adhesion of the glass fabric/epoxy tapes increased so much that the fabric failed before adhesion failure could be recorded. These tapes also showed the highest weight losses among those tested. Peel adhesion of the glass fabric/silicone tapes did not undergo large changes in value; weight losses were slightly more than 1%. Mylar tape with rubber adhesive failed the preliminary screening tests, and substantial weight loss accompanied blistering (Table A-8, Appendix A). Only one of the tapes in Table 14, the aluminized glass fabric/silicone (No. 5), was rated C.

Slight improvements in volume resistivity and dielectric strength of the tapes occurred. Curing, or the escape

Table 14. Summary of test results for the thermal sterilization procedure[a] on tapes

No.	Commercial designation	Material type	Manufacturer	Mechanical properties		Electrical properties						Thermal properties	Comments	Compatibility rating	References to manufacturer's literature
				Peel adhesion[b], oz/in. width		Volume resistivity[c], Ω-cm		Surface resistivity[c], Ω		Dielectric strength[c] v/mil		Weight[d] loss, %			
				Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure	Control	After thermal exposure				
1	Mystik 7000	Glass fabric/silicone adhesive	Mystik Tape Products	33.0	43.2	2.82×10^{14}	2.49×10^{14}	6.61×10^{14}	1.82×10^{14}	505	609	1.279	Slight darkening	M	102M, 103M
2	Mystik 7351	Mylar/rubber adhesive	Mystik Tape Products	—	—	—	—	—	—	—	—	—	Blisters; after preliminary thermal exposure, weight loss >3%; loss of adhesion	NC	102M, 103M
3	Scotch Tape No. 67, Electric Tape	Glass fabric/epoxy	3M Co.	25.6	Tape fails	2.77×10^{14}	2.25×10^{14}	1.16×10^{15}	2.16×10^{14}	1093	1097	2.513	Blisters; partial delamination; fabric fails	NC	98M
4	Tape No. 27	Glass fabric/epoxy	3M Co.	38	Tape fails	2.66×10^{14}	1.09×10^{15}	2.31×10^{13}	9.85×10^{13}	337	243	5.355	Slight darkening; fabric failure; high weight loss	NC	98M
5	Tape No. 7455	Al/glass fabric/silicone adhesive	Mystik Tape Products	38.6	34.1	8.84×10^{14}	1.05×10^{15}	9.94×10^{14}	2.83×10^{15}	166	184	1.052		C	102M, 103M

[a]Three cycles of 40 hr each at 300°F in a nitrogen atmosphere.
[b]ASTM D1000-62.
[c]ASTM D257.
[d]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

of polar volatile materials may have caused the improvements. An exception to the rule was Tape No. 27 (No. 4, Table 14). This product showed a 29% decrease in dielectric strength after thermal exposure.

A thermal/vacuum "cleaning" could increase the rating of some tapes to compatible.

9. General Results

Based on the criteria described in this report, about 47% of the polymeric products tested were rated compatible with the specified thermal sterilization conditions. About 30% were rated not compatible, and the remaining 23% were considered marginal.

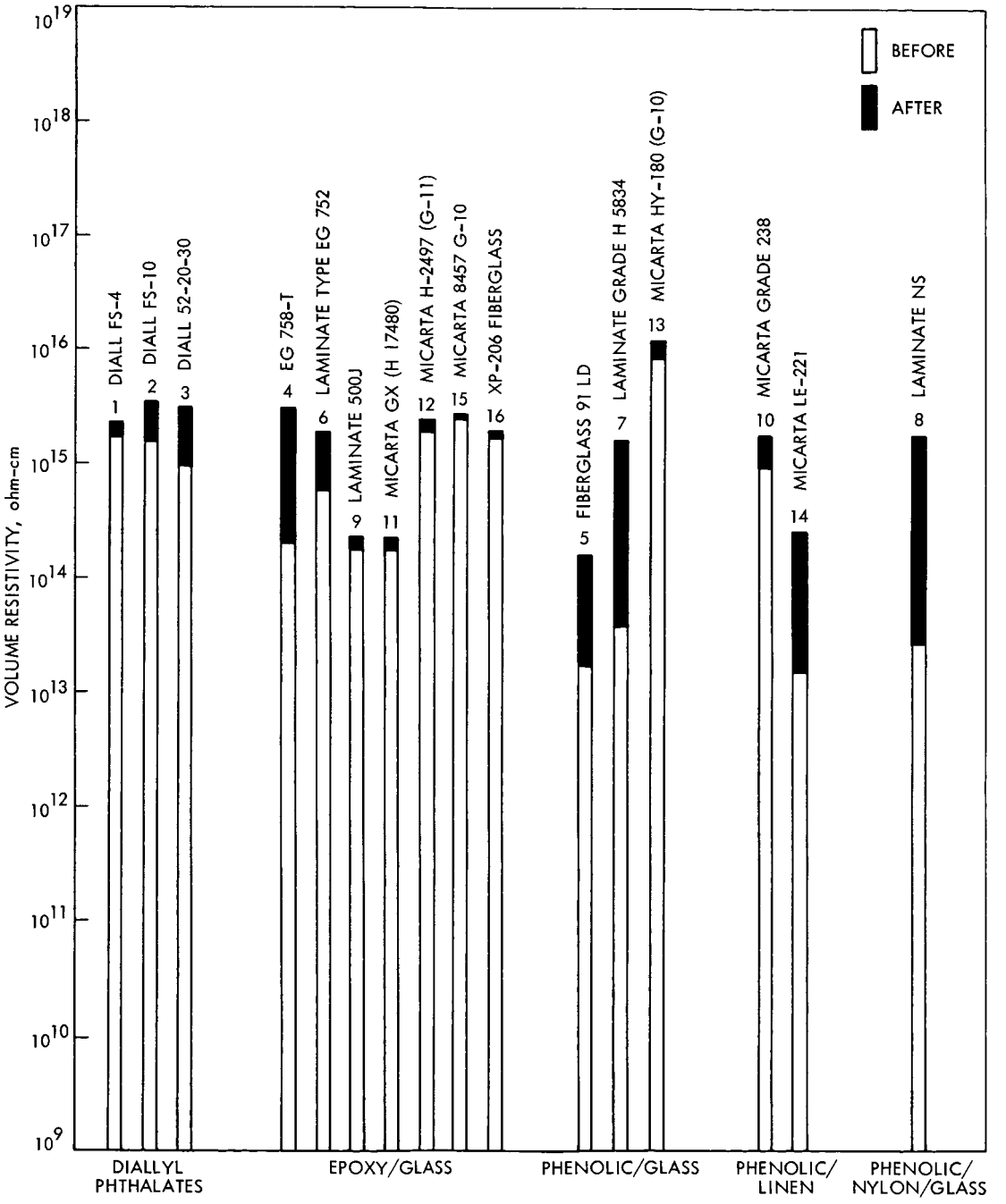

Fig. 12. Volume resistivities at room temperature of reinforced plastics before and after thermal exposure (3 cycles, 40 hr each at 300°F in nitrogen)

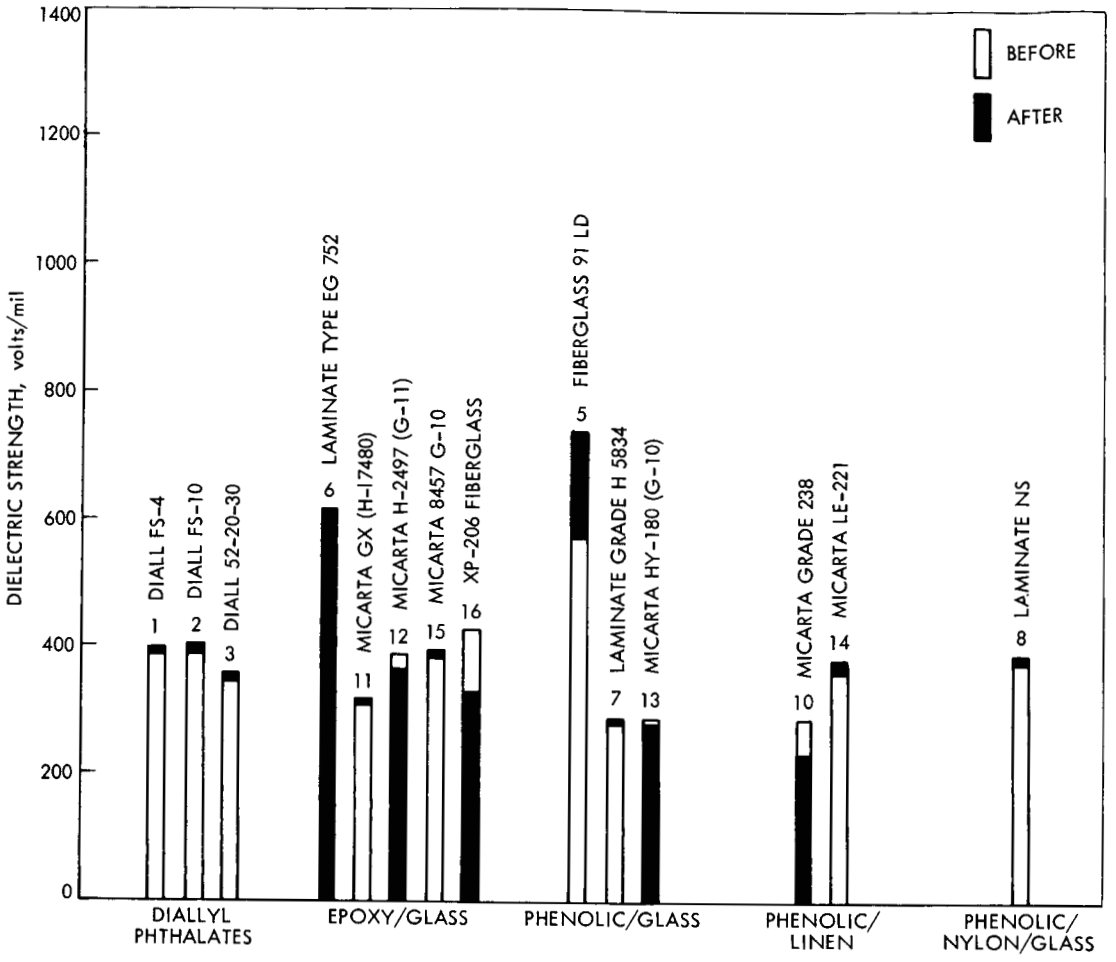

Fig. 13. Dielectric strength at room temperature of reinforced plastics before and after thermal exposure (3 cycles, 40 hr each at 300°F in nitrogen)

V. CONCLUSIONS

All the polymeric products tested were affected by the heat sterilization environment. The effects ranged from slight and inconsequential change in properties to changes sufficient to impair performance or destroy usefulness altogether.

The compatibility of a polymeric product to the thermal environment is dependent on the thermal stability of its basic polymeric constituent. Thus, many products made of the thermally stable polysiloxanes (silicones) were rated compatible, and none made of polysulfide or polychloroprene (neoprene) were so rated. The latter polymers are not noted for their heat resistance.

Other factors as well determine the thermal compatibility of a complex system like a polymeric product. For this reason, some of the silicone-based products were rated not compatible or marginal, although the same heat-stable polysiloxane used in compatible products was also their constituent polymer. The presence or absence of processing aids, fillers, diluents, plasticizers, antioxidants, or vulcanizing agents are some of

the determining ingredients in this regard. The purity of the resin or base polymer, the state of cure, and the homogeneity of the product are other factors.

Certain functional categories of products, such as the encapsulants, the tapes and the films, were more severely affected by the thermal sterilization treatment than others. Less than 25% of the total number of products in these three categories were rated compatible. The cleaning techniques of thermal, vacuum, and thermal/vacuum pretreatments to remove undesirable and damaging volatile materials will improve the chances of a compatible rating for some of these products. It may be necessary, however, to look for new materials or new combinations of known materials to fill the voids left by the removal of certain types of compounds from the list of polymeric products compatible with the heat sterilization environment.

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APPENDIX A

Preliminary Screening Program[3] Data

Table A-1. Preliminary screening test data for adhesives

No. (Table 4)	Commercial designation	Cure schedule		Thermal exposure conditions	Shear strength[a] at break, psi (stressed dimensions, 0.5 in. × 0.75 in.)	Weight loss[b], %	Comments
		Duration, hr	Temperature, °F				
1	A-4000 Dow Corning Adhesive	72	75	Unheated control	207 177 (avg.) 192		
				40 hr at 300°F	289 143 (avg.) 216	6.92 7.19 7.24 (avg.) 7.12	
2	Bonding Agent R-823	2	75	Unheated control	848 1419 (avg.) 1133		
				40 hr at 300°F	1363 1809 (avg.) 1586	5.09 4.78 5.50 (avg.) 5.12	Moderate darkening and clouding
3	Caram No. 206 Cement	4	75	Unheated control	(avg.) 133		
				40 hr at 300°F	123 136 (avg.) 130		
4	EC 1103	24	75	Unheated control	438 292 (avg.) 365		
				40 hr at 300°F	266 133 (avg.) 200	12.47 10.22 12.41 (avg.) 11.70	Yellows and hardens
5	EC 1614 B/A	48	75	Unheated control	1889 1868 (avg.) 1879		
				40 hr at 300°F	2137 2257 (avg.) 2197	0.363 1.08 0.433 (avg.) 0.625	

[a]Three aluminum panels bonded together in a "tuning fork" configuration; shear strength of the specimens determined using the Instron tensile tester.

[b]Weight loss determined using a Mettler Balance (Table 2).

[3]One cycle of 40 hr at 300°F in a nitrogen atmosphere.

Table A-1 (cont'd)

No. (Table 4)	Commercial designation	Cure schedule		Thermal exposure conditions	Shear strength[a] at break, psi (stressed dimensions, 0.5 in. × 0.75 in.)	Weight loss[b], %	Comments
		Duration, hr	Temperature, °F				
6	EC 2216 B/A	2	150	Unheated control	614 655 (avg.) 634		
				40 hr at 300°F	1367 1310 (avg.) 1339	0.506 0.661 0.619 (avg.) 0.595	Darkens
7	Eccobond 26A/B	4	75	Unheated control	224 235 (avg.) 230		
				40 hr at 300°F	621 600 (avg.) 610	4.57 4.53 4.48 (avg.) 4.53	Darkens and hardens
8	Eccobond 55/9	6	75	Unheated control	851 853 (avg.) 852		
				40 hr at 300°F	2214 1854 (avg.) 2034	0.271 0.349 (avg.) 0.310	Darkens
9	Eccobond 55/11	6	200	Unheated control	963 1184 (avg.) 1074		
				40 hr at 300°F	1467 2003 (avg.) 1735	1.95 0.920 0.810 (avg.) 1.23	Moderate lightening
10	Eccobond Solder 56C/9	2	120	Unheated control	422 353 (avg.) 388		
				40 hr at 300°F	554 725 (avg.) 639	0.459 0.334 0.444 (avg.) 0.412	Darkens
11	Eccobond Solder 57C A/B	1	200	Unheated control	489 699 (avg.) 594		
				40 hr at 300°F	1051 760 (avg.) 906	0.180 0.281 0.293 (avg.) 0.251	Develops yellow areas

Table A-1 (cont'd)

No. (Table 4)	Commercial designation	Cure schedule		Thermal exposure conditions	Shear strength[a] at break, psi (stressed dimensions, 0.5 in. × 0.75 in.)	Weight loss[b], %	Comments
		Duration, hr	Temperature, °F				
12	Epon 8/A	1½	200	Unheated control	1443 2044 (avg.) 1743		
				40 hr at 300°F	2868 2492 (avg.) 2680	1.35 0.524 1.63 (avg.) 1.17	Darkens
13	Epon 422	½	330	Unheated control	1012 1291 (avg.) 1152		
				40 hr at 300°F	1262 1307 (avg.) 1284	1.88 1.93 1.99 (avg.) 1.93	Darkens
14	Epon 828/A	¾	235	Unheated control	2289 1595 (avg.) 1942		
				40 hr at 300°F	1686 1467 (avg.) 1577	0.693 0.456 0.487 (avg.) 0.545	Moderate loss of color
15	Epon 828/Z	2 2	175 300	Unheated control	1648 1715 (avg.) 1681		
				40 hr at 300°F	1376 1528 (avg.) 1452	0.673 0 0 (avg.) 0.224	
16	Epon 901/B-1	1	200	Unheated control	2006 3268 (avg.) 2637		
				40 hr at 300°F	1713 1481 (avg.) 1597	0.109 0.091 1.26 (avg.) 0.487	Darkens
17	Epon 901/B-3	½ 1½	240 350	Unheated control	1595 1133 (avg.) 1364		
				40 hr at 300°F	995 1096 (avg.) 1046	0.528 0.546 0.094 (avg.) 0.389	Darkens

Table A-1 (cont'd)

No. (Table 4)	Commercial designation	Cure schedule		Thermal exposure conditions	Shear strength[a] at break, psi (stressed dimensions, 0.5 in. × 0.75 in.)	Weight loss[b], %	Comments
		Duration, hr	Temperature, °F				
18	Epon Pipelok 924A/B	6	75	Unheated control	1622 779 (avg.) 1200		
				40 hr at 300°F	2401 2164 (avg.) 2283	1.08 1.31 0.927 (avg.) 1.11	Color changed from purple to brown
19	E-Solder 3022	3	150	Unheated control	474 571 (avg.) 523		
				40 hr at 300°F	1614 1788 (avg.) 1702	2.17 1.82 1.66 (avg.) 1.88	Color changed from gray to brown
20	FM 96	½	Raise to 350 at 20 psi	Unheated control	1614 2196 (avg.) 1906		
		1	350 at 20 psi	40 hr at 300°F	2537 2177 (avg.) 2359	0.516 1.07 1.06 (avg.) 0.882	Color changed from brown to tan
21	FM 1044	¾	Raise to 330 at 1500 psi	Unheated control	(avg.) 2675		
		¾	340 at 1500 psi	40 hr at 300°F	1063 1045 (avg.) 1055	0 1.12 1.18 (avg.) 0.767	Darkens
22	GT 200	1	104	Unheated control	107 102 (avg.) 104.5		
				40 hr at 300°F	109 111 (avg.) 110	3.47 2.28 2.27 (avg.) 2.67	
23	HT 424	½	Raise to 330 under pressure	Unheated control	1764 1513 (avg.) 1640		

Table A-1 (cont'd)

No. (Table 4)	Commercial designation	Cure schedule		Thermal exposure conditions	Shear strength[a] at break, psi (stressed dimensions, 0.5 in. × 0.75 in.)	Weight loss[b], %	Comments
		Duration, hr	Temperature, °F				
23 (cont'd)	HT 424	½	330 under pressure	40 hr at 300°F	2668 2668 (avg.) 2668	1.34 0.915 1.07 (avg.) 1.11	Darkens
25	Number A2 Adhesive/A	2	165	Unheated control	933 1005 (avg.) 962		
				40 hr at 300°F	1558 1555 (avg.) 1556	0.403 0.283 0.324 (avg.) 0.337	Yellows
26	PC 12-007 A/B	2	167	Unheated control	4269 4269 (avg.) 4269		
				40 hr at 300°F	5870 5383 (avg.) 5627	5.43 5.30 4.95 (avg.) 5.23	Severe darkening
27	Proseal 501 Adhesive	48	75	Unheated control	76 77 (avg.) 77		
				40 hr at 300°F	58 66 (avg.) 62	17.07 17.46 17.85 (avg.) 17.5	Darkens and blisters
28	RTV 102	280	75	Unheated control	2455 3002 (avg.) 2729		
				40 hr at 300°F	2768 1748 (avg.) 2258	3.05 2.78 2.57 (avg.) 2.80	Very slight darkening
30	RTV 140	24	75	Unheated control	213 261 (avg.) 237		
				40 hr at 300°F	195 264 (avg.) 230	0.182 0.074 0.071 (avg.) 0.082	
31	RTV 891	24	75	Unheated control	172 185 (avg.) 179		
				40 hr at 300°F	147 105 (avg.) 126	0.560 0.682 0.642 (avg.) 0.612	

Table A-2. Preliminary screening test data for coatings

No. (Table 5)	Commercial designation	Cure schedule		Thermal exposure conditions	Appearance	Micro-blister test[a]	Gouge-shear test[b]	Flexibility test[c]	Comments
		Duration, hr	Temperature, °F						
1	Alkenex Varnish 9522	2	Room temperature	Unheated control	Transparent	Pass	H	Pass	
		4	100	40 hr at 300°F	Brown	Pass	3H	Pass	
2	B-224-2 Tuffernell Varnish	6	Room temperature	Unheated control	Clear, transparent	Pass	H	Pass	
				40 hr at 300°F	Severe darkening	Pass	>8H	Pass	
3	B-276 Clear Air Drying Varnish	24	Room temperature	Unheated control	Clear, transparent	Pass	H	Pass	
				40 hr at 300°F	Yellowed	Pass	6H	Pass	
5	Cat-A-Lac 463-1 Flat White	7 days	Room temperature	Unheated control	White, flat	Pass	2H	Fail	Cracking and adhesion loss
				40 hr at 300°F	Severe darkening	Pass	>8H	Fail	Cracking and adhesion loss
6	Cat-A-Lac 463-1-8 Flat Black	7 days	Room temperature	Unheated control	Black, flat	Pass	F	Fail	Cracking and adhesion loss
				40 hr at 300°F	No change	Pass	>8H	Fail	Crazing
7	Corlar 585/586	72	Room temperature	Unheated control	Black, glossy	Pass	H	Fail	Crazing and adhesion loss
				40 hr at 300°F	No change	Pass	7H	Fail	Crazing and adhesion loss
8	D 25 W2 Speedprint Ink	24	Room temperature	Unheated control	White, flat	Pass	H	Fail	Cracking and adhesion loss
				40 hr at 300°F	Yellowed	Pass	H	Fail	Crazing

[a]Qualitative test to determine adhesion of the coating to an aluminum panel: two parallel scratches, approximately one inch apart, were made with a razor blade through the coating to the metal. A 1-in. wide strip of masking tape, with the adhesive side down, was bonded between the two scratches. Tape was then removed with one quick motion and examined for particles from the substrate.

[b]A semi-quantitative test to evaluate the adhesion of coatings to an aluminum panel. Drawing pencil leads of the following hardnesses were used:

3B—2B—B—HB—F—H—2H—3H—4H—5H—6H—7H—8H
(softer) (harder).

The hardness of pencil lead required to rupture the coating was recorded.

[c]The test panel, with coated side uppermost, was bent over the edge of a workbench. The film in the region of the bend was then examined under bright light for cracking, crazing, and loss of adhesion.

Table A-2 (cont'd)

No. (Table 5)	Commercial designation	Cure schedule		Thermal exposure conditions	Appearance	Micro-blister test[a]	Gouge-shear test[b]	Flexibility test[c]	Comments
		Duration, hr	Temperature, °F						
11	Eccocoat EC 200 A/B	6	Room temperature	Unheated control	Clear, transparent	Fail	H	Pass	
				40 hr at 300°F	Slight yellowing	Pass	>8H	Pass	
12	Eccocoat IC 2	1	Room temperature	Unheated control	Clear, glossy	Fail	H	Pass	
		2	250	40 hr at 300°F	Yellowed	Pass	>3B	Pass	
13	Eccocoat VE A/B	24	Room temperature	Unheated control	Colorless	Pass	F	Pass	
				40 hr at 300°F	Darkening	Pass	2H	Pass	
14	Eccosil No. 33	24	Room temperature	Unheated control	Pink, transparent	Pass	H	Fail	Crazing, no adhesion loss
				40 hr at 300°F	No change	Pass	6H	Pass	
15	Fungicidal Varnish 220F	5	Room temperature	Unheated control	Clear, glossy	Pass	5H	Pass	
				40 hr at 300°F	Yellowed	Pass	>8H	Pass	
16	Hi-Heat Aluminum Paint 171-A-28	1	450	Unheated control	Aluminum	Fail	<3B	Pass	Slight removal of paint film by micro-blister test
				40 hr at 300°F	No change	Pass	H	Pass	
17	Insl-x U86	1	Room temperature	Unheated control	Clear, glossy	Fail	F	Pass	
		5	200	40 hr at 300°F	Yellowed	Pass	6H	Pass	
18	Interchemical 12412	72	Room temperature	Unheated control	Black, glossy	Pass	3H	Pass	
				40 hr at 300°F	No change	Pass	>8H	Fail	Cracking and adhesion loss
19	Laminar X500	120	Room temperature	Unheated control	White, opaque	Pass	4H	Pass	
				40 hr at 300°F	Yellowed	Fail	5H	Fail	Cracking and adhesion loss
20	Number 73-X Ink	24	Room temperature	Unheated control	Black, opaque	Pass	H	Pass	
				40 hr at 300°F	No change	Pass	2H	Pass	

Table A-2 (cont'd)

No. (Table 5)	Commercial designation	Cure schedule		Thermal exposure conditions	Appearance	Micro-blister test[a]	Gouge-test[b] shear	Flexibility test[c]	Comments
		Temperature, °F	Duration, hr						
21	Number 445 Silicone Water Repellent	24	Room temperature	Unheated control	Milky	Pass	4H	Pass	
				40 hr at 300°F	No change	Pass	8H	Pass	
	Paint W 2374, Black	24	Room temperature	Unheated control	Black, glossy	Pass	H	Pass	
				40 hr at 300°F	No change	Pass	8H	Pass	
23	Perma-Dri Ink 177	24	Room temperature	Unheated control	Black, opaque	Pass	8H	Pass	
				40 hr at 300°F	No change	Pass	8H	Pass	
25	Pyre-ML Varnish RK692	1	220	Unheated control	Transparent	Pass	4H	Pass	
		1	300						
		1	420						
				40 hr at 300°F	Darkened	Pass	5H	Pass	
26	SR 290	24	Room temperature	Unheated control	Slightly milky	Pass	3B	Pass	
				40 hr at 300°F	No change	Pass	H	Pass	
27	Tuf-On 747-8	24	Room temperature	Unheated control	Yellowish	Pass	F	Pass	
				40 hr at 300°F	Dark brown	Fail	5H	Fail	
28	UC 11659	1	350	Unheated control	Aluminum	Fail	<3B	Fail	Cracking and adhesion loss
				40 hr at 300°F	No change	Fail	H	Fail	Cracking and adhesion loss
29	Uralane 241/973	24	Room temperature	Unheated control	Clear, glossy	Fail	F	Pass	
				40 hr at 300°F	Slight yellowing	Pass	F	Pass	

Table A-3. Preliminary screening test data for elastomers

No. (Table 6)	Commercial designation	Thermal exposure conditions	Mechanical properties						Weight Loss[c], %	Comments
			Shore A hardness[a]	Stressed dimensions, in.	Tensile strength[b], psi at 25% strain	Modulus[b], psi at 25% strain	Tensile strength[b], psi	Tensile modulus[b], psi		
1	AMS 3195	Unheated control	(avg.) 18	0.755/0.132 0.758/0.130	25 25 (avg.) 25	101 99 (avg.) 100	—	—		
		40 hr at 300°F	(avg.) 22	0.756/0.134 0.761/0.131	27 28 (avg.) 27.5	107 110 (avg.) 108.5	—	—	0.625 0.584 0.709 (avg.) 0.639	
2	B-318-7/70	Unheated control	—	—	—	—	(avg.) 1132	(avg.) 790		
		40 hr at 300°F	—	—	—	—	(avg.) 1298	(avg.) 646	1.88 1.97 2.05 (avg.) 1.97	
3	Butyl Rubber 805-70	Unheated control	(avg.) 79	0.755/0.082 0.748/0.081	231 237 (avg.) 234	927 950 (avg.) 938.5	—	—		
		40 hr at 300°F	(avg.) 84	0.746/0.081 0.742/0.082	264 261 (avg.) 262.5	1057 1047 (avg.) 1052	—	—	1.58 1.64 1.68 (avg.) 1.63	
4	Hadbar XB 800-71	Unheated control	—	—	—	—	(avg.) 2006	(avg.) 1842		
		40 hr at 300°F	—	—	—	—	(avg.) 1658	(avg.) 1888	(avg.) 0.24	
5	Hadbar 1000/80	Unheated control	—	—	—	—	(avg.) 688	(avg.) 909		
		40 hr at 300°F	—	—	—	—	(avg.) 610	(avg.) 942	(avg.) 0.11	
6	Hadbar 4000/80	Unheated control	—	—	—	—	(avg.) 899	(avg.) 918		
		40 hr at 300°F	—	—	—	—	(avg.) 962	(avg.) 953	None	
7	Hadbar 5000/50	Unheated control	—	—	—	—	(avg.) 712	(avg.) 294		
		40 hr at 300°F	—	—	—	—	(avg.) 741	(avg.) 416	None	
8	L-308-80	Unheated control	—	—	—	—	(avg.) 985	(avg.) 1291		
		40 hr at 300°F	—	—	—	—	(avg.) 721	(avg.) 1358	(avg.) 0.271	

[a]ASTM D676-59T.

[b]ASTM D412-62T with the following modification: sample configuration was a strip 0.75 in. × 5 in. with emery cloth bonded to each end to prevent tensile jaw slippage.

[c]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

Table A-3 (cont'd)

No. (Table 6)	Commercial designation	Thermal exposure conditions	Mechanical properties						Weight Loss[c], %	Comments
			Shore A hardness[a]	Stressed dimensions, in.	Tensile strength[b], psi at 25% strain	Modulus[b], psi at 25% strain	Tensile strength[b], psi	Tensile modulus[b], psi		
9	L-449-6/60	Unheated control	—	—	—	—	(avg.) 641	(avg.) 533		
		40 hr at 300°F	—	—	—	—	(avg.) 654	(avg.) 599	(avg.) 0.26	
10	N-195-7/70	Unheated control	—	—	—	—	(avg.) 2273	(avg.) 1288		
		40 hr at 300°F	—	—	—	—	(avg.) 1321	(avg.) 1418	(avg.) 1.72	
11	PMP 42011 AE	Unheated control	(avg.) 69	0.745/0.076 0.752/0.072	210 213 (avg.) 211.5	841 850 (avg.) 845.5	—	—		
		40 hr at 300°F	(avg.) 80	0.729/0.076 0.728/0.082	382 378 (avg.) 380	1527 1510 (avg.) 1518	—	—	6.12 5.72 5.74 (avg.) 5.86	Flexibility decreased
12	PMP 6035	Unheated control	(avg.) 68	0.755/0.079 0.752/0.079	201 206 (avg.) 203.5	803 826 (avg.) 814.5	—	—		
		40 hr at 300°F	(avg.) 71	0.755/0.075 0.749/0.059	241 247 (avg.) 244	963 986 (avg.) 974.5	—	—	0.093 0.193 0.198 (avg.) 0.161	
13	PMP 6100	Unheated control	(avg.) 55	0.755/0.072 0.753/0.072	97 97 (avg.) 97	386 386 (avg.) 386	—	—		
		40 hr at 300°F	(avg.) 57	0.751/0.071 0.741/0.071	105 106 (avg.) 105.5	420 424 (avg.) 422	—	—	0.260 0.296 0.259 (avg.) 0.272	Yellowed
16	RTV 501	Unheated control	(avg.) 46	0.735/0.200 0.754/0.232	134 115 (avg.) 124.5	537 463 (avg.) 500	—	—		
		40 hr at 300°F	(avg.) 40	0.736/0.214 0.736/0.228	77 72 (avg.) 74.5	310 288 (avg.) 299	—	—	0.630 0.545 0.508 (avg.) 0.561	Slight darkening

Table A-3 (cont'd)

No. (Table 6)	Commercial designation	Thermal exposure conditions	Mechanical properties						Weight Loss[c], %	Comments
			Shore A hardness[a]	Stressed dimensions, in.	Tensile strength[b], psi at 25% strain	Modulus[b], psi at 25% strain	Tensile strength[b], psi	Tensile modulus[b], psi		
17	RTV 615 A/B	Unheated control	(avg.) 53	—	62[d] 63[d] (avg.) 62.5	124[d] 126[d] (avg.) 125	—	—		
		40 hr at 300°F	(avg.) 55	—	113[d] 123[d] (avg.) 118	226[d] 246[d] (avg.) 236	—	—	0.439 0.364 (avg.) 0.401	
18	Rubber 1814	Unheated control	(avg.) 73	0.755/0.045 0.764/0.044	147 149 (avg.) 148	588 595 (avg.) 591.5	—	—		
		40 hr at 300°F	(avg.) 73	0.745/0.045 0.746/0.045	126 122 (avg.) 124	504 486 (avg.) 495	—	—	1.47 1.53 1.53 (avg.) 1.51	
19	S-417-7	Unheated control	—	—	—	—	(avg.) 658	(avg.) 398		
		40 hr at 300°F	—	—	—	—	(avg.) 738	(avg.) 444	0.221 0.222 0.127 (avg.) 0.190	
20	Silastic 1410 (Heat Shrinkable)	Unheated control	(avg.) 81	0.743/0.041 0.748/0.040	232 241 (avg.) 236.5	926 966 (avg.) 947.5	—	—		
		40 hr at 300°F	(avg.) 65	0.300/0.098 0.300/0.098	114 186 (avg.) 150	457 746 (avg.) 601.5	—	—	0.704 0.600 0.503 (avg.) 0.602	Slight darkening
21	Silicone Rubber 1050-70	Unheated control	(avg.) 72	0.757/0.079 0.752/0.081	224 254 (avg.) 239	897 1016 (avg.) 956.5	—	—		
		40 hr at 300°F	(avg.) 75	0.747/0.069 0.742/0.077	289 261 (avg.) 275	1159 1045 (avg.) 1102	—	—	0.214 0.125 0.147 (avg.) 0.162	

[d]50% strain.

Table A-3 (cont'd)

No. (Table 6)	Commercial designation	Thermal exposure conditions	Mechanical properties						Weight Loss[c], %	Comments
			Shore A hardness[a]	Stressed dimensions, in.	Tensile strength[b], psi at 25% strain	Modulus[b], psi at 25% strain	Tensile strength[b], psi	Tensile modulus[b], psi		
22	Silicone Sheet 391-5	Unheated control	(avg.) 64	0.751/0.069 0.751/0.068	374 366 (avg.) 370	1498 1468 (avg.) 1483	—	—		
		40 hr at 300°F	(avg.) 65	0.750/0.067 0.749/0.060	413 394 (avg.) 403.5	1654 1577 (avg.) 1615.5	—	—	0.258 0.271 0.280 (avg.) 0.270	
23	SR 349-70	Unheated control	(avg.) 82	0.753/0.030 0.759/0.029	221 215 (avg.) 218	885 862 (avg.) 873.5	—	—		
		40 hr at 300°F	(avg.) 88	0.741/0.030 0.748/0.029	414 395 (avg.) 404.5	1658 1582 (avg.) 1620	—	—	3.19 3.22 3.27 (avg.) 3.23	
24	SR 613-75	Unheated control	(avg.) 88	0.760/0.021 0.758/0.022	503 491 (avg.) 497	1509 1473 (avg.) 1491	—	—		
		40 hr at 300°F	(avg.) 86	0.754/0.022 0.747/0.022	217 228 (avg.) 222.5	869 912 (avg.) 890.5	—	—	1.18 1.24 1.28 (avg.) 1.23	
25	Viton B 60	Unheated control	(avg.) 77	0.762/0.061 0.751/0.061	248 249 (avg.) 248.5	994 996 (avg.) 995	—	—		
		40 hr at 300°F	(avg.) 77	0.756/0.061 0.749/0.061	246 246 (avg.) 246	985 985 (avg.) 985	—	—	0.005 0.018 0.006 (avg.) 0.009	
27	Viton 77-545	Unheated control	—	—	—	—	(avg.) 1477	(avg.) 1196		
		40 hr at 300°F	—	—	—	—	(avg.) 1651	(avg.) 1466	0.141 0.141 0.282 (avg.) 0.188	

Table A-4. Preliminary screening test data for encapsulants

No. (Table 8)	Commercial designation	Cure schedule		Thermal exposure conditions	Mechanical properties				Physical and thermal properties		Comments
		Duration, hr	Temperature, °F		Shore[a] hardness	Stressed dimensions, in.	Tensile strength[b], psi	Madulus[b], psi	Weight loss[c], %	Dimensional change[d], %	
1	Apcofoam 1414-1.5/EPV	2	175	Unheated control	—	1.000 × 1.000	3.4	170			
						1.000 × 1.000	3.8	175			
						1.000 × 1.000	3.9	165			
							(avg.) 3.7	(avg.) 170			
				40 hr at 300°F	—	1.000 × 1.000	1.9	45	13.640	—	Slight darkening
						1.000 × 1.000	2.0	94	14.750		
						1.000 × 1.000	2.0	60	14.160		
							(avg.) 1.9	(avg.) 66	(avg.) 14.180		
2	Eccofoam FP/12-6	1	150	Unheated control	—	1.000 × 1.000	29.5	1970			
						0.470 × 0.460	21.4	600			
						0.480 × 0.480	28.3	940			
						0.500 × 0.490	28.1	1470			
							(avg.) 26.8	(avg.) 1245			
				40 hr at 300°F	—	← Complete failure →			6.700	—	Color change from pink to yellow, complete failure of foam
									6.420		
									6.040		
									6.500		
									(avg.) 6.410		
3	Eccofoam S	Used as supplied		Unheated control	—	0.995 × 0.987	(avg.) 2.5	(avg.) 115			
				40 hr at 300°F	—	0.987 × 0.995	(avg.) 2.4	(avg.) 63	0.460	l = 0	Yellowed, warping
									0.367	w = 0	
									0.365	h = 0	
									(avg.) 0.397		
4	Eccosil 5000	24	Room temperature	Unheated control	—	—	—	—			
		2	205								
				40 hr at 300°F	—	—	—	—	1.000	—	—
									0.909		
									0.916		
									(avg.) 0.942		

[a]ASTM D676-59T.

[b]ASTM D412-62T with the following modification: sample configuration was a strip 0.75 in. × 5 in. with emery cloth bonded to each end to prevent tensile jaw slippage.

[c]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

[d]Volume measurements determined using Ames Micrometer Dial Gage, accurate to ±0.1 mil.

Table A-4 (cont'd)

No. (Table 8)	Commercial designation	Cure schedule		Thermal exposure conditions	Mechanical properties				Physical and thermal properties		Comments
		Duration, hr	Temperature, °F		Shore[a] hardness	Stressed dimensions, in.	Tensile strength[b], psi	Modulus[b], psi	Weight loss[c], %	Dimensional change[d], %	
5	Epocast 202/9615	4	150	Unheated control	(avg.) 80 D	—	1932.0 1840.0 (avg.) 1886.0	779 557 (avg.) 668			
				40 hr at 300°F	(avg.) 84 D	—	4000.0 3856.0 (avg.) 3928.0	461 455 (avg.) 458	7.100 7.220 7.160 (avg.) 7.160	l = 2.21 w = 3.00 h = 0	Severe darkening
6	Epocast 212/951	2	150	Unheated control	(avg.) 85 D	—	1452.0 1356.0 (avg.) 1404.0	453 535 (avg.) 494			
				40 hr at 300°F	(avg.) 86 D	—	2400.0 1116.0 (avg.) 1758.0	259 259 (avg.) 259	1.420 1.400 (avg.) 1.410	l = 0.404 w = 0 h = 0	Severe yellowing
7	Hapex 1200A/Hardener 1210	4 2 2	180 200 300	Unheated control	(avg.) 85 D	—	—	—			
				40 hr at 300°F	(avg.) 85 D	—	—	—	0.302 0.284 0.334 (avg.) 0.307	l = 0 w = 0 h = 0	
10	Polycel 440R	—	—	Unheated control	—	0.475 × 0.470 × 3.50 0.480 × 0.475 × 3.50 0.472 × 0.468 × 3.50	25.0 30.3 26.5 (avg.) 27.2	2700 2800 2500 (avg.) 2666			
				40 hr at 300°F	—	0.485 × 0.465 × 3.50 0.485 × 0.470 × 3.50 0.480 × 0.465 × 3.50	17.7 8.2 15.8 (avg.) 13.9	1800 1700 2500 (avg.) 2000	5.720 5.880 5.880 (avg.) 5.830	—	Slight darkening

Table A-4 (cont'd)

No. (Table 8)	Commercial designation	Cure schedule		Thermal exposure conditions	Mechanical properties				Physical and thermal properties		Comments
		Duration, hr	Temperature, °F		Shore[a] hardness	Stressed dimensions, in.	Tensile strength[b], psi	Modulus[b], psi	Weight loss[c], %	Dimensional change[d], %	
11	PR 1527 A/B	6	180	Unheated control	(avg.) 86 A	0.752 × 0.051 × 2.00	544.0	2177			
						0.753 × 0.051 × 2.00	500.0	2000			
							(avg.) 522.0[e]	(avg.) 2088			
				40 hr at 300°F	(avg.) 65 A	0.754 × 0.051 × 2.00	148.0	590	0.228	l = 0.6	
						0.757 × 0.051 × 2.00	150.0	599	0.113	w = 0	
							(avg.) 149.0[e]	(avg.) 595	0.157	h = 0	
									(avg.) 0.166		
12	PR 1930-2/PR 1902	72	Room temperature	Unheated control	(avg.) 57 A	0.754 × 0.168 × 2.00	241.0	963			
						0.757 × 0.186 × 2.00	211.0	842			
							(avg.) 226.0[e]	(avg.) 902			
				40 hr at 300°F	(avg.) 49 A	0.745 × 0.166 × 2.00	130.0	521	1.060	l = 0.5	
						0.736 × 0.166 × 2.00	136.0	543	1.070	w = 0.8	
							(avg.) 133.0[e]	(avg.) 532	1.080	h = 0	
									(avg.) 1.070		
13	ProSeal 777	6	180	Unheated control	(avg.) 71 A	0.742 × 0.057 × 2.00	305.0	1218			
		1	275			0.757 × 0.054 × 2.00	299.0	1195			
							(avg.) 302.0[e]	(avg.) 1206			
				40 hr at 300°F	(avg.) 68 A	0.753 × 0.057 × 2.00	192.0	766	0.804	l = 0.2	Slight darkening
						0.751 × 0.057 × 2.00	200.0	802	0.731	w = 0	
							(avg.) 196.0[e]	(avg.) 784	0.592	h = 0	
									(avg.) 0.709		
16	RTV-60/Thermolite 12	24	Room temperature	Unheated control	(avg.) 71 A	—	374.0	748			
							374.0	748			
							(avg.) 374.0[f]	(avg.) 748			
				40 hr at 300°F	(avg.) 68 A	—	294.0	588	0.908	l = 0.504	
							294.0	588	0.904	w = 0.66	
							(avg.) 294.0[f]	(avg.) 588	(avg.) 0.906	h = 0	

[e]Tensile strength at 25% elongation.
[f]Tensile strength at 50% elongation.

Table A-4 (cont'd)

No. (Table 8)	Commercial designation	Cure schedule		Thermal exposure conditions	Mechanical properties				Physical and thermal properties		Comments
		Duration, hr	Temperature, °F		Shore[a] hardness	Stressed dimensions, in.	Tensile strength[b], psi	Modulus[b], psi	Weight loss[c], %	Dimensional change[d], %	
20	Scotchcast 260	½	400	Unheated control	(avg.) 85 D	—	—	—			
				40 hr at 300°F	(avg.) 85 D	—	—	—	0.862 0.882 (avg.) 0.872	l = 0.220 w = 0 h = 0	
21	Scotchcast Resin No. 3	2	250	Unheated control	(avg.) 80 D	—	—	—			
				40 hr at 300°F	(avg.) 82 D	—	—	—	3.260 2.830 (avg.) 3.040	l = 0.992 w = 1.00 h = 0	Severe darkening
22	Scotchcast Resin 241A/B	8	205	Unheated control	(avg.) 59 D	—	—	—			
				40 hr at 300°F	(avg.) 60 D	—	—	—	2.680 2.480 (avg.) 2.580	l = 1.00 w = 1.30 h = 0	
26	Stycast 1090/9	24	Room temperature	Unheated control	(avg.) 79 D	—	—	—			
				40 hr at 300°F	(avg.) 81 D	—	—	—	(avg.) 0	l = 0.806 swelling w = 0 h = 0	Slight darkening
27	Stycast 1090/11	2	212	Unheated control	(avg.) 80 D	—	—	—			
				40 hr at 300°F	(avg.) 83 D	—	—	—	0.351 0.401 (avg.) 0.376	l = 0.402 w = 0.510 h = 0	
28	Stycast 1264A/B			Unheated control	—	—	1470 2490 (avg.) 1980	245 580 (avg.) 413			
				40 hr at 300°F	—	—	2650 2880 (avg.) 2765	663 360 (avg.) 512	3.46 3.27 (avg.) 3.36	—	Yellowed
29	Stycast 2651/11	3	215	Unheated control	(avg.) 89 D	—	—	—			
				40 hr at 300°F	(avg.) 90 D	—	—	—	0.901 0.799 (avg.) 0.850	l = 0.201 w = 0.500 h = 0	Darkened

Table A-4 (cont'd)

No. (Table 8)	Commercial designation	Cure schedule		Thermal exposure conditions	Mechanical properties				Physical and thermal properties		Comments
		Duration, hr	Temperature, °F		Shore[a] hardness	Stressed dimensions, in.	Tensile strength[b], psi	Modulus[b], psi	Weight loss[c], %	Dimensional change[d], %	
30	Stycast 2741/15	½	160	Unheated control	(avg.) 93 A	—	4250 4730 (avg.) 4490	300 320 (avg.) 310			
				40 hr at 300°F	(avg.) 99 A	—	5570 6040 (avg.) 5805	328 350 (avg.) 339	2.67 2.64 2.63 (avg.) 2.65	l = 1.41 w = 2.22 h = 0	Color change from gray to brown
31	Stycast 2850 GT/9	24	Room temperature	Unheated control	(avg.) 91 D	—	—	—			
				40 hr at 300°F	(avg.) 93 D	—	—	—	0.197 0.190 (avg.) 0.193	l = 0.803 swelling w = 0 h = 9.09	
32	Stycast 3050/9	¼	250	Unheated control	(avg.) 90 D	—	—	—			
				40 hr at 300°F	(avg.) 91 D	—	—	—	1.36 1.36 (avg.) 1.36	l = 0 w = 0.500 h = 0	Color changed from pink to brown
33	Sylgard 182	4	300	Unheated control	(avg.) 55 A	—	—	—			
				40 hr at 300°F	(avg.) 53 A	—	—	—	0.656 0.677 (avg.) 0.666	l = 0.249 w = 0 h = 0	

Table A-5. Preliminary screening test data for films

No. (Table 9)	Commercial designation	Thermal exposure conditions	Mechanical properties				Comments
			Stressed dimensions, in.	Tensile strength[a], psi	Modulus[a], psi	Weight loss[b], %	
1	H-Film (Kapton)	Unheated control	0.5 × 0.003	5060	120476		
				5840	121667		
				(avg.) 5450	(avg.) 121072		
		40 hr at 300°F		4980	113182		
				5020	109130		
				(avg.) 5000	(avg.) 111156		
2	Mylar Type A (10 mils)	Unheated control	0.5 × 0.01	14720	441644		
				14480	434443		
				(avg.) 14600	(avg.) 438044		
		40 hr at 300°F		15200	407146	0.390	
				15520	439249	0.381	
				(avg.) 15360	(avg.) 423198	0.401	
						(avg.) 0.391	
3	Mylar Type C (1 mil)	Unheated control	0.5 × 0.001	14213	507619		
				13893	496190		
				(avg.) 14053	(avg.) 501904		
		40 hr at 300°F		14560	520000	0.330	Slight clouding
				14400	432043	0.546	
				(avg.) 14480	(avg.) 476022	(avg.) 0.438	
4	Mylar Type D (3 mils)	Unheated control	—	—	—		
		40 hr at 300°F		—	—	0.476	Slight clouding
						0.476	
						(avg.) 0.476	
5	Mylar Type D (5 mils)	Unheated control	—	—	—		
		40 hr at 300°F		—	—	0.269	Very slight clouding
						0.268	
						(avg.) 0.269	
6	Mylar Type HS	Unheated control	0.5 × 0.001	14554	507686		
				14554	428054		
				(avg.) 14554	(avg.) 467870		
		40 hr at 300°F		19477	239370	0	
				19723	321590	0	
				(avg.) 19600	(avg.) 280480	0	
						(avg.) 0	
7	Mylar M22 (1 mil)	Unheated control	0.5 × 0.001	11638	447627		
				11574	413373		
				(avg.) 11606	(avg.) 430500		
		40 hr at 300°F		11829	347935	5.05	Severe darkening
				12213	339244	5.26	
				(avg.) 12021	(avg.) 343590	(avg.) 5.10	

[a]ASTM D882-63T with the following modification: sample configuration was a strip 0.75 in. × 5 in.

[b]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

Table A-5 (cont'd)

No. (Table 9)	Commercial designation	Thermal exposure conditions	Mechanical properties				Comments
			Stressed dimensions, in.	Tensile strength[a], psi	Modulus[a], psi	Weight loss[b], %	
8	Tedlar 200 AM 30 WH	Unheated control	0.5 × 0.002	5710	237917		
				5700	259091		
				(avg.) 5705	(avg.) 248504		
		40 hr at 300°F		6300	277937	0.153	Darkened slightly
				6420	291818	0.147	
				(avg.) 6360	(avg.) 284878	0.134	
						(avg.) 0.145	

Table A-6. Preliminary screening test data for lubricants (oils and greases)

No. (Table 11)	Commercial designation	Thermal exposure condition	Weight loss[a], %	Comments
1	Aeroshell Grease 7A	Unheated control		Light brown grease
		40 hr at 300°F	5.75	Dark brown; no apparent change in consistency
			6.04	
			5.13	
			(avg.) 5.64	
2	Apiezon Grease T	Unheated control		Brown grease
		40 hr at 300°F		Melts below 300°F, and flows badly
3	DC-5 Grease	Unheated control		White grease
		40 hr at 300°F	0.650	Slight yellowing; no apparent change in consistency
			0.544	
			0.525	
			(avg.) 0.573	
4	DC-11 Grease	Unheated control		White grease
		40 hr at 300°F	1.26	Slight yellowing; no apparent change in consistency
			1.19	
			1.20	
			(avg.) 1.22	
5	DC-200, 350cs	Unheated control		Water-white fluid
		40 hr at 300°F	(avg.) 0.033	No change in appearance
6	Diallyl Phthalate	Unheated control		
		40 hr at 300°F	(avg.) 99.4	Samples evaporated
7	Versilube F-50	Unheated control		Colorless fluid
		40 hr at 300°F	0.236	No change in appearance; slight gain in weight, probably due to absorption of contaminants from oven
			0.317	
			0.344	
			(avg.) 0.299 (gain in weight)	

[a]Weight loss determined using a Mettler Balance, Model H15, accurate to ±.01 mg.

Table A-7. Preliminary screening test data for reinforced plastics

No. (Table 12)	Commercial designation	Thermal exposure conditions	Mechanical properties					Comments
			Stressed dimensions, in.	Tensile strength[a], psi	Elongation[a], %	Modulus[a], psi	Weight loss[b], %	
1	Diall FS-4	Unheated control		2920		97500		
		40 hr at 300°F		5400		82000	0.214	
							0.236	
							(avg.) 0.225	
2	Diall FS-10	Unheated control		1350		52400		
		40 hr at 300°F		4060		70400	0.220	
							0.202	
							(avg.) 0.211	
3	Diall 52-20-30	Unheated control		3300		60000		
		40 hr at 300°F		5100		93000	0.394	
							0.352	
							(avg.) 0.373	
4	EG 758-T	Unheated control	0.100/0.063	50700	6.5	780000		
			0.098/0.063	47500	5.2	910000		
				(avg.) 49100	(avg.) 5.8	(avg.) 845000		
		40 hr at 300°F	0.098/0.063	50000	5.7	880000	(avg.) 0	
			0.100/0.063	48400	6.6	730000		
				(avg.) 49200	(avg.) 6.2	(avg.) 805000		
5	Fiberglass 91 LD	Unheated control	0.097/0.065	35000	4.5	770000		
			0.102/0.065	41600	4.8	960000		
				(avg.) 38300	(avg.) 4.6	(avg.) 865000		
		40 hr at 300°F	0.100/0.062	36000	4.1	870000	1.12	Slight darkening
			0.100/0.060	36000	4.4	820000	1.17	
				(avg.) 36000	(avg.) 4.2	(avg.) 845000	1.24	
							(avg.) 1.18	
6	Laminate Type EG 752	Unheated control	0.109/0.012	41500	2.8	1480000		
			0.107/0.012	36600	2.2	1660000		
				(avg.) 39050	(avg.) 2.5	(avg.) 1570000		
		40 hr at 300°F	0.107/0.012	40800	2.7	1510000	0.442	Slight darkening
			0.109/0.012	40700	2.9	1400000	0.495	
				(avg.) 40750	(avg.) 2.8	(avg.) 1455000	0.480	
							(avg.) 0.472	
7	Laminate Grade H 5834	Unheated control	0.201/0.132	37500	20.5	180000		
			0.197/0.133	34600	18.5	190000		
				(avg.) 36050	(avg.) 19.5	(avg.) 185000		
		40 hr at 300°F	0.201/0.131	32600	20.6	160000	1.81	Slight darkening
			0.197/0.131	32500	20.5	160000	1.81	
				(avg.) 32550	(avg.) 20.5	(avg.) 160000	1.77	
							(avg.) 1.80	

[a]ASTM D638-61T with the following modification: sample configuration was a strip 0.75 in. × 5 in.

[b]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

Table A-7 (cont'd)

No. (Table 12)	Commercial designation	Thermal exposure conditions	Mechanical properties					Comments
			Stressed dimensions, in.	Tensile strength[a], psi	Elongation[a], %	Modulus[a], psi	Weight loss[b], %	
8	Laminate NS	Unheated control	0.201/0.091	6700	2.9	230000		
			0.197/0.091	6920	3.4	200000		
				(avg.) 6810	(avg.) 3.1	(avg.) 215000		
		40 hr at 300°F	0.194/0.091	7200	3.1	230000	2.39	Darkened
			0.198/0.091	7300	3.5	210000	2.37	
				(avg.) 7250	(avg.) 3.3	(avg.) 220000	2.39	
							(avg.) 2.38	
9	Laminate 500J	Unheated control	0.107/0.067	46600	4.5	1030000		
			0.102/0.063	40800	3.7	1100000		
				(avg.) 43700	(avg.) 4.1	(avg.) 1065000		
		40 hr at 300°F	0.104/0.064	38500	4.8	800000	—	Slight darkening
			0.103/0.063	42500	3.6	1190000		
				(avg.) 40500	(avg.) 4.2	(avg.) 995000		
10	Micarta Grade 238	Unheated control	0.204/0.068	9130	3.0	3000000		
			0.195/0.061	10600	3.2	3310000		
				(avg.) 9865	(avg.) 3.1	(avg.) 3155000		
		40 hr at 300°F	0.201/0.066	9300	2.7	3440000	3.59	Slight darkening
			0.203/0.066	9400	3.3	2840000	3.57	
				(avg.) 9350	(avg.) 3.0	(avg.) 3140000	3.59	
							(avg.) 3.58	
11	Micarta GX (H 17480)	Unheated control	0.100/0.067	35000	9.2	380000		
			0.102/0.067	33500	7.8	430000		
				(avg.) 34250	(avg.) 8.5	(avg.) 405000		
		40 hr at 300°F	0.096/0.067	33000	8.7	380000	0.499	Darkened
			0.097/0.067	34500	9.0	380000	0.476	
				(avg.) 33750	(avg.) 8.8	(avg.) 380000	0.477	
							(avg.) 0.484	
12	Micarta H-2497 (G-11)	Unheated control	0.197/0.032	43600	4.9	890000		
			0.198/0.032	47500	4.5	1000000		
				(avg.) 45550	(avg.) 4.7	(avg.) 945000		
		40 hr at 300°F	0.199/0.032	48300	5.1	950000	0.295	Yellowed
			0.197/0.032	48300	5.4	890000	0.297	
				(avg.) 48300	(avg.) 5.2	(avg.) 920000	0.344	
							(avg.) 0.312	
14	Micarta LE-221	Unheated control	0.191/0.062	16900	5.3	320000		
			0.195/0.062	16600	5.0	330000		
				(avg.) 16750	(avg.) 5.1	(avg.) 325000		
		40 hr at 300°F	0.201/0.062	16500	5.1	320000	2.88	Darkened
			0.196/0.062	16900	5.2	330000	2.87	
				(avg.) 16700	(avg.) 5.1	(avg.) 325000	2.87	
							(avg.) 2.87	

Table A-7 (cont'd)

No. (Table 12)	Commercial designation	Thermal exposure conditions	Mechanical properties					Comments
			Stressed dimensions, in.	Tensile strength[a], psi	Elongation[a], %	Modulus[a], psi	Weight loss[b], %	
15	Micarta 8457 G-10	Unheated control	0.096/0.064	45000	5.0	900000		
			0.106/0.063	41000	4.8	850000		
				(avg.) 43000	(avg.) 4.9	(avg.) 875000		
		40 hr at 300°F	0.096/0.064	44000	4.8	910000	0.322	Severe darkening
			0.100/0.065	37000	4.1	900000	0.305	
				(avg.) 40500	(avg.) 4.4	(avg.) 905000	0.331	
							(avg.) 0.319	

Table A-8. Preliminary screening test data for tapes

No. (Table 14)	Commercial designation	Thermal exposure conditions	Tensile strength[a], psi	Weight loss[b], %	Comments
1	Mystik 7000	Unheated control	18 19 (avg.) 18.5		
		40 hr at 300°F	25 20 (avg.) 22.5	0.997 1.120 0.931 (avg.) 1.016	No observable changes
2	Mystik 7351	Unheated control	21 22 (avg.) 21.5		
		40 hr at 300°F	27 26 (avg.) 26.5	3.03 2.99 3.20 (avg.) 3.07	Slight yellowing; some loss of adhesion
3	Scotch Tape No. 67, Electric Tape	Unheated control	45 36 (avg.) 40.5		
		40 hr at 300°F	80 80 (avg.) 80	3.50 3.37 3.34 (avg.) 3.40	Tape failure; color lightens from dark brown to light brown
4	Tape No. 27	Unheated control	92 82 (avg.) 87		
		40 hr at 300°F	150 177 (avg.) 163.5	3.07 3.04 3.06 (avg.) 3.06	Noticeable darkening from beige to tan; no observable change in adhesion or degree of brittleness
5	Tape No. 7455	Unheated control	29 31 (avg.) 30		
		40 hr at 300°F	59 59 (avg.) 59	0.625 0.791 0.824 (avg.) 0.747	No observable changes

[a]Test consists of bonding two tapes to the ends of two aluminum plates. The two plates are pulled apart and the load necessary to unbond or fracture the tapes is recorded, together with the crosshead displacement of the two plates.

[b]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

APPENDIX B

Complete Thermal Sterilization Program[4] Data

Table B-1. Thermal sterilization test data for adhesives

No. (Table 4)	Commercial designation	Cure schedule for unheated controls		Mechanical properties					
				Shore hardness[a]		Shear strength[b]			
						Unheated controls		Three cycles of 40 hr at 300°F	
		Duration, hr	Temperature, °F	Unheated controls	Three cycles of 40 hr at 300°F	Stressed dimensions, in.	Shear strength, psi	Stressed dimensions, in.	Shear strength, psi
1	A-4000 Dow Corning Adhesive	18	120	40 A	40 D	0.998/1.003	120	1.003/1.015	245
				39 A	38 D	1.000/1.020	195	1.004/1.012	165
				46 A	39 D	1.005/1.006	180	1.002/1.012	190
				(avg.) 41 A	(avg.) 39 D	1.006/1.015	135	1.000/0.990	225
							(avg.) 157		(avg.) 206
2	Bonding Agent R-823	20	Room temperature	70 A	85 D	1.003/1.004	610	1.011/1.008	940
		2	212	69 A	85 D	1.003/1.015	980	1.008/1.007	1,320
				68 A	83 D	1.002/1.009	780	1.005/1.005	1,310
				(avg.) 69 A	(avg.) 84 D	1.005/1.005	765	1.010/1.000	695
							(avg.) 784		(avg.) 1,065
3	Caram No. 206 Cement	72	Room temperature	60 A	64 A	1.005/1.008	190	1.005/1.006	195
				58 A	68 A	1.004/1.008	170	1.004/1.008	180
				61 A	68 A	1.008/1.004	150	1.006/1.010	220
				(avg.) 59 A	(avg.) 67 A	1.002/1.008	140	1.007/1.005	110
							(avg.) 162		(avg.) 176
4	EC 1103	24	Room temperature	(avg.) 20 A	(avg.) 65 A	1.008/0.999	125	1.000/1.010	940
						1.005/1.010	105	1.006/0.987	765
						1.007/1.010	95	0.997/1.007	950
						1.010/1.010	110	1.010/1.010	625
							(avg.) 110		(avg.) 820
5	EC 1614 B/A	48	Room temperature	—	—	0.995/1.060	2,070	0.996/1.017	1,190
						0.998/0.990	1,665	0.997/1.015	2,155
						0.940/1.010	2,290	0.998/1.004	1,290
						0.998/1.015	1,825	0.998/1.030	1,240
						0.998/1.017	2,400	0.998/1.030	2,235
							(avg.) 2,050		(avg.) 1,620
6	EC 2216 B/A	24	Room temperature	70 A	60 A	1.006/1.010	435	1.008/1.000	940
				75 A	60 A	1.005/1.012	550	1.005/0.990	890
				72 A	64 A	1.005/1.000	510	1.003/0.990	1,330
				(avg.) 72 A	(avg.) 61 A	1.003/1.009	625	1.005/1.010	730
						1.004/1.008	410		(avg.) 972
							(avg.) 505		

[a] ASTM D676–59T.

[b] FTMS #175–Method 1033.1T.

[4] Three cycles of 40 hr each at 300°F in a nitrogen atmosphere.

Table B-1 (cont'd)

No. (Table 4)	Commercial designation	Cure schedule for unheated controls		Mechanical properties					
				Shore hardness[a]		Shear strength[b]			
						Unheated controls		Three cycles of 40 hr at 300°F	
		Duration, hr	Temperature, °F	Unheated controls	Three cycles of 40 hr at 300°F	Stressed dimensions, in.	Shear strength, psi	Stressed dimensions, in.	Shear strength, psi
7	Eccobond 26 A/B	24	Room temperature	(avg.) 80 A	(avg.) 94 A	1.007/1.005	745	1.002/0.985	730
						0.999/1.002	730	0.996/0.991	635
						1.001/1.000	1,300	1.000/1.002	860
						1.002/0.997	740		(avg.) 741
						1.005/1.000	1,320		
							(avg.) 970		
8	Eccobond 55/9	30	Room temperature	82 D	88 D	1.000/0.990	190	1.000/0.990	1,070
				85 D	85 D	0.996/0.998	175	1.004/0.992	895
				80 D	81 D	1.000/0.998	175	1.000/0.985	970
				(avg.) 82 D	(avg.) 85 D	1.000/1.002	150	1.002/1.006	1,080
							(avg.) 172		(avg.) 1,003
9	Eccobond 55/11	½	300	54 D	62 D	1.005/1.002	215	1.000/0.996	540
				55 D	65 D	1.006/0.990	200	1.000/1.006	750
				50 D	63 D	1.007/1.000	275	1.000/1.007	580
				(avg.) 53 D	(avg.) 63 D	1.005/1.005	215	1.000/1.007	870
						1.006/0.996	190	0.999/1.000	570
							(avg.) 220		(avg.) 660
10	Eccobond Solder 56C/9	2	120	80 D	85 D	1.003/1.005	315	0.997/0.998	350
				83 D	83 D	0.995/0.996	165	1.003/0.998	315
				84 D	84 D	1.001/1.003	185	0.997/0.998	290
				(avg.) 82 D	(avg.) 83 D	1.000/0.996	320	0.998/0.985	200
							(avg.) 245		(avg.) 290
11	Eccobond Solder 57C A/B	1	200	85 D	76 D	0.998/0.990	525	1.000/1.002	730
				85 D	82 D	0.999/0.996	720	1.000/0.999	690
				83 D	78 D	0.996/1.002	490	0.995/1.030	595
				(avg.) 84 D	(avg.) 79 D	1.002/1.010	495	0.997/1.002	515
						0.999/0.995	600		(avg.) 630
							(avg.) 565		
12	Epon 8/A	1½	200	70 D	75 D	1.005/1.000	500	1.005/1.000	1,960
				73 D	73 D	1.009/1.002	560	1.004/0.998	1,840
				80 D	78 D	1.005/1.005	375	1.005/1.002	1,730
				(avg.) 74 D	(avg.) 75 D	1.000/0.996	375	1.001/0.990	2,020
						1.009/1.005	455	1.006/1.003	1,980
							(avg.) 455		(avg.) 1,910
13	Epon 422	½	330	—	—	1.000/1.013	1,150	0.997/1.030	1,065
						0.999/1.005	940	1.000/1.001	1,040
						1.000/1.030	1,025	1.000/0.990	1,020
						0.995/1.005	1,245	0.995/1.010	1,150
						1.000/1.012	1,255	0.998/1.007	1,230
							(avg.) 1,123		(avg.) 1,101

Table B-1 (cont'd)

No. (Table 4)	Commercial designation	Cure schedule for unheated controls		Mechanical properties					
				Shore hardness[a]		Shear strength[b]			
						Unheated controls		Three cycles of 40 hr at 300°F	
		Duration, hr	Temperature, °F	Unheated controls	Three cycles of 40 hr at 300°F	Stressed dimensions, in.	Shear strength, psi	Stressed dimensions, in.	Shear strength, psi
14	Epon 828/A	2	235	74 D	70 D	0.995/1.023	1,260	1.001/1.005	2,000
				74 D	70 D	0.999/1.019	1,060	0.995/1.000	1,140
				68 D	70 D	0.995/1.018	1,310	0.999/1.000	1,540
				(avg.) 72 D	(avg.) 70 D	0.997/1.031	1,140	0.998/1.005	1,320
						0.996/1.002	1,100	0.997/1.005	1,745
							(avg.) 1,174		(avg.) 1,540
15	Epon 828/Z	2	175	—	—	1.000/1.018	1,725	0.997/1.010	1,140
		2	300			1.000/1.005	1,575	0.995/1.016	1,930
						1.000/0.995	1,540	1.000/1.017	1,360
						1.000/0.993	1,220	1.003/1.016	1,315
						1.002/1.020	1,120	1.003/1.005	1,415
							(avg.) 1,435		(avg.) 1,430
16	Epon 901/B-1	1	200	80 D	81 D	0.999/1.002	475	0.999/0.983	1,230
				80 D	82 D	1.002/1.000	525	0.998/1.002	1,270
				84 D	82 D	0.995/1.005	545	0.995/1.004	970
				(avg.) 81 D	(avg.) 81 D	0.997/1.004	520	1.000/0.993	1,410
							(avg.) 516		(avg.) 1,220
17	Epon 901/B-3	½	240	66 D	70 D	1.000/0.995	590	1.000/1.005	1,110
		1½	350	72 D	76 D	1.005/1.006	855	1.001/1.009	845
				72 D	76 D	0.999/1.003	730	1.000/1.035	930
				(avg.) 70 D	(avg.) 74 D	0.997/1.000	600	1.002/1.025	1,010
						1.000/1.005	930	0.994/0.992	1,300
							(avg.) 740		(avg.) 1,040
18	Epon Pipelok 924A/B	6	75	—	—	1.000/0.998	940	0.970/0.998	2,200
						1.000/1.002	2,050	0.990/1.010	2,625
						1.000/1.002	2,225	1.000/1.020	2,205
						1.000/1.004	2,150	1.000/1.005	2,130
						1.000/1.010	1,880	1.000/1.040	2,090
							(avg.) 1,849		(avg.) 2,250
19	E-Solder 3022	1½	185	47 D	79 D	1.005/1.009	895	1.010/1.000	1,220
				45 D	83 D	0.999/1.000	945	1.005/1.006	1,190
				49 D	84 D	1.005/1.005	950	1.005/1.007	1,250
				(avg.) 47 D	(avg.) 82 D	1.008/1.000	940	1.005/1.002	1,120
							(avg.) 932	1.000/1.000	1,250
									(avg.) 1,210
20	FM 96	2	350	—	—	1.006/0.997	905	1.005/1.001	1,110
						1.008/1.008	1,030	1.002/0.990	1,090
						1.000/1.010	915	1.004/0.994	1,190
						1.000/0.990	1,030	1.002/0.990	980
						1.007/1.006	850	1.005/1.010	1,230
							(avg.) 945		(avg.) 1,120

Table B-1 (cont'd)

No. (Table 4)	Commercial designation	Cure schedule for unheated controls		Mechanical properties					
				Shore hardness[a]		Shear strength[b]			
						Unheated controls		Three cycles of 40 hr at 300°F	
		Duration, hr	Temperature, °F	Unheated controls	Three cycles of 40 hr at 300°F	Stressed dimensions, in.	Shear strength, psi	Stressed dimensions, in.	Shear strength, psi
21	FM 1044	¾	340	—	—	0.996/1.003	2,150	1.000/1.007	2,720
						0.998/0.990	2,245	0.995/1.006	2,700
						0.996/0.990	2,325	0.998/1.005	2,725
						0.999/1.003	2,350	1.000/1.002	2,500
						0.998/1.008	2,475	0.996/0.993	2,475
							(avg.) 2,310		(avg.) 2,625
22	GT 200	1	104	—	—	0.996/0.997	150	0.995/1.000	152
						0.975/0.985	155	0.943/0.975	170
						0.982/0.985	160	0.986/0.965	170
						1.018/1.000	150		(avg.) 164
						0.992/0.995	170		
							(avg.) 157		
23	HT 424	1¾	350	—	—	1.004/1.013	1,670	1.006/1.010	1,350
						1.003/1.005	1,620	1.000/1.002	1,570
						1.005/1.001	1,860	1.002/1.012	1,410
						1.007/1.015	1,540	1.002/1.013	1,260
							(avg.) 1,672	1.005/1.007	1,130
									(avg.) 1,340
24	Hysol 5150/3690	72	Room temperature	54 D	71 D	1.008/1.030	1,490	0.995/1.020	2,680
				54 D	77 D	1.003/1.000	1,860	1.013/1.012	2,710
				58 D	75 D	1.008/0.985	1,420	1.007/1.012	2,500
				(avg.) 55 D	(avg.) 74 D	1.005/1.005	1,980	1.001/0.995	2,260
						1.002/0.993	1,830		(avg.) 2,537
							(avg.) 1720		
25	Number A-2 Adhesive/A	2½	200	84 D	80 D	1.004/1.000	690	1.000/0.978	1,360
				84 D	90 D	1.000/0.990	650	1.002/0.995	1,260
				85 D	90 D	1.004/0.995	875	1.000/0.985	1,590
				(avg.) 84 D	(avg.) 87 D	1.002/1.000	1,000	1.005/1.011	1,560
							(avg.) 804	1.002/0.994	1,420
									(avg.) 1,440
26	PC 12-007 A/B	2½	167	71 A	74 D	1.008/1.025	725	1.001/0.992	400
				71 A	76 D	1.002/0.996	730	1.010/0.992	500
				70 A	78 D	1.005/1.008	765	1.002/1.100	455
				(avg.) 70 A	(avg.) 76 D	1.007/1.003	665	1.000/1.004	470
						1.007/1.003	650		(avg.) 456
							(avg.) 705		
27	Proseal 501 Adhesive	48	Room temperature	—	—	0.985/0.990	175	0.975/0.994	50
						1.010/1.010	180	1.000/0.990	70
						0.950/1.008	180	1.000/0.985	65
						1.010/1.020	170	0.995/0.964	75
						1.016/1.020	175	0.998/1.000	60
							(avg.) 174		(avg.) 64

Table B-1 (cont'd)

No. (Table 4)	Commercial designation	Cure schedule for unheated controls		Mechanical properties					
				Shore hardness[a]		Shear strength[b]			
						Unheated controls		Three cycles of 40 hr at 300°F	
		Duration, hr	Temperature, °F	Unheated controls	Three cycles of 40 hr at 300°F	Stressed dimensions, in.	Shear strength, psi	Stressed dimensions, in.	Shear strength, psi
28	RTV 102	1 week	Room temperature	20 A	40 A	1.007/1.022	130	1.005/1.010	325
				22 A	40 A	1.005/1.020	145	1.006/1.010	365
				18 A	41 A	1.003/1.011	200	1.004/1.015	380
				(avg.) 20 A	(avg.) 40 A	1.005/1.003	215	1.004/1.005	375
							(avg.) 172		(avg.) 361
29	RTV 108	1 week	Room temperature	14 A	36 A	1.000/1.015	125	1.002/1.020	225
				14 A	37 A	1.000/1.004	155	1.003/1.028	295
				15 A	37 A	0.998/1.005	140	1.006/1015	205
				(avg.) 14 A	(avg.) 36 A	1.004/1.020	74	1.006/1.007	120
						1.005/1.010	85	1.005/1.006	115
							(avg.) 115		(avg.) 190
30	RTV 140	1 week	Room temperature	29 A	35 A	1.005/1.010	160	1.005/1.006	200
				30 A	34 A	1.004/1.016	180	1.003/1.010	245
				30 A	34 A	1.006/1.015	170	1.007/1.005	265
				(avg.) 29 A	(avg.) 34 A	1.008/1.014	170	1.006/1.012	235
						1.006/1.004	215	1.005/1.006	235
							(avg.) 180		(avg.) 235
31	RTV 891	96	Room temperature	—	—	1.001/1.028	160	1.000/1.025	225
						1.003/1.010	185	1.000/1.002	220
						1.004/1.005	180	1.001/1.002	255
						1.002/1.030	150	1.002/1.017	230
						1.002/1.015	196	1.003/0.994	260
							(avg.) 175		(avg.) 240

Table B-2. Thermal sterilization test data for coatings and inks

No. (Table 5)	Commercial designation	Cure schedule		Thermal exposure conditions	Mechanical properties			Electrical properties			
		Duration, hr	Temperature, °F		Thickness, mil	Scrape adhesion[a], kg	Flexibility[b] (cold cracking)	Thickness, mil	Volume resistivity[c] Ω-cm	Surface resistivity[c] Ω	Dielectric strength[c], v/mil
1	Alkenex Varnish 9522	2	Room temperature	Unheated control	1.5	7.0	Pass	1.2	—	—	458
		4	100		2.0	7.0	Pass	0.8			687
					2.0	6.5	Pass	1.1			409
						(avg.) 6.8					(avg.) 585
				Three cycles of 40 hr at 300°F	1.2	9.0	Pass	1.0	—	—	500
					1.5	9.0	Pass	0.8			780
					1.5	9.0	Pass	1.6			640
						(avg.) 9.0					(avg.)
2	B-224-2 Tuffernell Varnish	6	Room temperature	Unheated control	0.4	10.0	Pass	1.700	5.09×10^{14}	3.87×10^{15}	1,530
					0.5	>10.0	Pass	1.400	8.53×10^{14}	4.64×10^{15}	1,570
					0.5	>10.0	Pass		(avg.) 6.81×10^{14}	(avg.) 4.25×10^{15}	(avg.) 1,550
						(avg.) >10.0					
				Three cycles of 40 hr at 300°F	0.5	9.5	Pass		—	—	1,880
					0.5	9.0	Pass				2,140
					0.6	9.5	Pass				1,580
						(avg.) 9.3					(avg.) 1,810
4	Cat-A-Lac 443-1 Gloss White	7 days	Room temperature	Unheated control	3.0	5.0	Fail	2.8	1.49×10^{14}	1.00×10^{15}	1,640
					3.0	5.0	Fail	3.1	1.16×10^{14}	1.39×10^{15}	1,290
					3.0	5.0	Fail	2.8	9.96×10^{13}	9.29×10^{14}	1,460
						(avg.) 5.0			(avg.) 1.20×10^{14}	(avg.) 1.10×10^{15}	(avg.) 1,463
				Three cycles of 40 hr at 300°F	2.5	7.5	Fail	2.9	9.59×10^{13}	1.00×10^{14}	1,190
					2.5	8.0	Fail	3.1	1.33×10^{14}	3.87×10^{14}	1,105
					2.5	10.0	Fail	2.8	9.96×10^{13}	5.42×10^{14}	1,080
						(avg.) 8.5			(avg.) 1.00×10^{14}	(avg.) 3.43×10^{14}	(avg.) 1,125
5	Cat-A-Lac 463-1 Flat White	7 days	Room temperature	Unheated control	5.0	5.0	Fail	5.0	8.99×10^{13}	1.31×10^{15}	1,020
					4.5	5.0	Fail	4.9	4.05×10^{13}	6.97×10^{14}	1,130
					5.0	5.0	Fail	4.7	1.69×10^{14}	9.29×10^{14}	1,170
						(avg.) 5.0			(avg.) 9.98×10^{13}	(avg.) 9.78×10^{14}	(avg.) 1,106
				Three cycles of 40 hr at 300°F	4.0	>10.0	Fail	4.5	5.94×10^{14}	1.00×10^{15}	1,090
					4.0	>10.0	Fail	4.5	3.26×10^{14}	3.71×10^{14}	1,110
					4.5	>10.0	Fail	4.4	4.56×10^{14}	8.52×10^{14}	1,140
						(avg.) >10.0			(avg.) 4.58×10^{14}	(avg.) 7.41×10^{14}	(avg.) 1,113

[a]ASTM D2197–63T.

[b]FTMS #141, Method 6223.

[c]ASTM D257.

Table B-2 (cont'd)

No. (Table 5)	Commercial designation	Cure schedule		Thermal exposure conditions	Mechanical properties			Electrical properties			
		Duration, hr	Temperature, °F		Thickness, mil	Scrape adhesion[a], kg	Flexibility[b] (cold cracking)	Thickness, mil	Volume resistivity[c] Ω-cm	Surface resistivity[c] Ω	Dielectric strength[c], v/mil
6	Cat-A-Lac 463-1-8 Flat Black	7 days	Room temperature	Unheated control	6.5	>10.0	Fail	3.5	4.69×10^{13}	1.93×10^{15}	915
					5.6	>10.0	Fail	3.0	6.93×10^{13}	3.87×10^{15}	885
					6.0	>10.0	Fail	3.3	5.42×10^{13}	2.71×10^{15}	990
						(avg.) >10.0			(avg.) 5.68×10^{13}	(avg.) 2.83×10^{15}	(avg.) 930
				Three cycles of 40 hr at 300°F	5.5	>10.0	Fail	3.0	1.84×10^{13}	6.19×10^{10}	550
					5.5	>10.0	Fail	3.4	3.71×10^{13}	7.59×10^{10}	530
					6.3	>10.0	Fail	3.3	3.50×10^{13}	5.42×10^{10}	500
						(avg.) >10.0			(avg.) 3.00×10^{13}	(avg.) 6.33×10^{10}	(avg.) 526
7	Corlar 585/586	72	Room temperature	Unheated control	1.9	2.0	Pass	1.0	5.91×10^{15}	6.19×10^{14}	330
					1.2	2.0	Pass	1.0	8.87×10^{15}	4.64×10^{14}	410
					1.9	2.0	Pass	1.0	1.53×10^{16}	5.73×10^{14}	380
						(avg.) 2.0			(avg.) 9.90×10^{15}	(avg.) 5.52×10^{14}	(avg.) 373
				Three cycles of 40 hr at 300°F	1.5	2.5	Pass	1.0	7.39×10^{14}	3.09×10^{14}	320
					1.2	2.0	Pass	1.0	5.91×10^{14}	3.40×10^{14}	360
					1.5	2.5	Pass	1.0	1.47×10^{15}	2.78×10^{14}	220
						(avg.) 2.3			(avg.) 9.10×10^{14}	(avg.) 3.09×10^{14}	(avg.) 300
8	D 25 W2 Speedprint Ink	24	Room temperature	Unheated control	2.5	1.0	Fail	3.6	1.28×10^{13}	2.01×10^{14}	575
					2.1	1.0	Fail	3.2	6.89×10^{14}	8.67×10^{14}	690
					2.4	1.5	Fail	4.3	1.74×10^{15}	9.29×10^{14}	880
						(avg.) 1.2			(avg.) 8.00×10^{14}	(avg.) 6.65×10^{14}	(avg.) 715
				Three cycles of 40 hr at 300°F	2.5	1.5	Fail	4.7	7.36×10^{15}	6.97×10^{14}	385
					2.8	1.5	Fail	3.5	6.65×10^{15}	6.19×10^{14}	412
					2.0	1.5	Fail	2.8	7.97×10^{15}	5.42×10^{14}	239
						(avg.) 1.5			(avg.) 7.32×10^{15}	(avg.) 6.19×10^{14}	(avg) 345
9	Electrofilm Lube-Lok 2396	1	Room temperature	Unheated control	2.0	1.5	Pass	1.0	6.21×10^{7}	2.71×10^{5}	0
		2	180		2.0	1.5	Fail	0.8	1.15×10^{8}	4.95×10^{5}	0
		2	400		2.0	1.5	Fail	0.8	4.47×10^{7}	1.54×10^{5}	0
						(avg.) 1.5			(avg.) 7.39×10^{7}	(avg.) 3.06×10^{5}	(avg.) 0
				Three cycles of 40 hr at 300°F	2.0	1.5	Pass	0.8	(avg.) 6.71×10^{7}	(avg.) 3.09×10^{5}	(avg.) 0
					2.0	1.5	Pass				
					2.0	1.5	Pass				
						(avg.) 1.5					

Table B-2 (cont'd)

No. (Table 5)	Commercial designation	Cure schedule		Thermal exposure conditions	Mechanical properties			Electrical properties			
		Duration, hr	Temperature, °F		Thickness, mil	Scrape adhesion[a], kg	Flexibility[b] (cold cracking)	Thickness, mil	Volume resistivity[c] Ω-cm	Surface resistivity[c] Ω	Dielectric strength[c], v/mil
10	Electrofilm Lube-Lok 4306	1	Room temperature	Unheated control	1.6	6.0	Pass	0.9	2.17×10^{16}	2.44×10^{14}	400
		1½	375		1.7	7.0	Pass	0.7	7.45×10^{16}	2.10×10^{14}	1,210
					1.8	6.0	Pass	0.6	(avg.) 4.81×10^{16}	(avg.) 2.27×10^{14}	(avg.) 805
						(avg.) 6.3					
				Three cycles of 40 hr at 300°F	1.5	4.5	Pass	0.8	4.47×10^{16}	2.47×10^{13}	640
					1.8	2.5	Pass	0.9	3.63×10^{16}	3.40×10^{14}	580
					1.9	4.5	Pass	0.7	(avg.) 4.05×10^{16}	5.42×10^{14}	640
						(avg.) 3.8				(avg.) 3.02×10^{14}	(avg.) 716
11	Eccocoat EC 200 A/B	6	Room temperature	Unheated control	1.0	0.5	Pass	1.3	2.25×10^{15}	2.32×10^{15}	154
					1.1	0.5	Pass	1.4	4.99×10^{15}	3.09×10^{15}	164
					1.0	0.5	Pass	1.4	2.91×10^{15}	2.32×10^{15}	164
						(avg.) 0.5			(avg.) 3.38×10^{15}	(avg.) 2.57×10^{13}	(avg.) 160
				Three cycles of 40 hr at 300°F	1.0	5.0	Pass	1.3	6.30×10^{15}	3.09×10^{15}	154
					1.5	5.0	Pass	1.2	1.46×10^{16}	2.32×10^{15}	167
					2.5	4.5	Pass		(avg.) 1.04×10^{16}	(avg.) 2.70×10^{15}	(avg.) 160
						(avg.) 4.8					
12	Eccocoat IC 2	1	Room temperature	Unheated control	8.0	6.0	Pass	105.0	6.76×10^{11}	6.81×10^{13}	419
		2	250		4.0	7.0	Pass	93.0	8.26×10^{11}	2.94×10^{13}	485
					8.0	7.5	Pass	96.0	1.04×10^{12}	6.19×10^{13}	485
						(avg.) 6.8			(avg.) 8.47×10^{11}	(avg.) 5.31×10^{12}	(avg.) 463
				Three cycles of 40 hr at 300°F	6.0	7.5	Pass	49.0	4.02×10^{12}	7.74×10^{13}	700
					5.0	7.5	Pass	59.0	3.72×10^{12}	1.23×10^{14}	840
					7.0	8.0	Pass	44.0	3.92×10^{12}	1.31×10^{14}	1,080
						(avg.) 7.6			(avg.) 3.89×10^{12}	(avg.) 1.10×10^{13}	(avg.) 873
13	Eccocoat VE A/B	24	Room temperature	Unheated control	2.0	6.5	Pass	1.2	5.87×10^{12}	2.32×10^{12}	590
					2.0	7.5	Pass	1.2	6.85×10^{12}	3.87×10^{11}	710
					1.9	5.5	Pass	1.5	4.84×10^{12}	2.01×10^{11}	835
						(avg.) 6.5			(avg.) 5.85×10^{12}	(avg.) 2.73×10^{11}	(avg.) 711
				Three cycles of 40 hr at 300°F	1.0	4.0	Pass	1.2	1.12×10^{16}	3.09×10^{14}	1,040
					1.0	4.5	Pass	1.5	9.68×10^{15}	5.42×10^{14}	1,200
					1.0	7.5	Pass	1.3	1.80×10^{16}	3.71×10^{14}	1,170
						(avg.) 5.3			(avg.) 1.29×10^{16}	(avg.) 4.07×10^{14}	(avg.) 1,136

Table B-2 (cont'd)

No. (Table 5)	Commercial designation	Cure schedule		Thermal exposure conditions	Mechanical properties			Electrical properties			
		Duration, hr	Temperature, °F		Thickness, mil	Scrape adhesion[a], kg	Flexibility[b] (cold cracking)	Thickness, mil	Volume resistivity[c] Ω-cm	Surface resistivity[c] Ω	Dielectric strength[c], v/mil
14	Eccosil No. 33	24	Room temperature	Unheated control	1.8	0.5	Fail	0.600	1.10×10^{14}	6.97×10^{13}	1,000
					1.8	0.5	Fail	0.700	3.32×10^{13}	5.26×10^{13}	1,000
					1.8	0.5	Fail	0.500	(avg.) 7.10×10^{13}	(avg.) 6.11×10^{13}	1,000
						(avg.) 0.5					(avg.) 1,000
				Three cycles of 40 hr at 300°F	1.8	1.0	Pass	0.700	2.14×10^{15}	6.97×10^{13}	1,000
					1.8	1.0	Pass	0.600	7.02×10^{14}	4.02×10^{13}	830
					1.8	1.0	Pass	0.800	1.30×10^{15}	8.52×10^{13}	870
						(avg.) 1.0			(avg.) 1.38×10^{15}	(avg.) 6.50×10^{13}	(avg.) 900
15	Fungicidal Varnish 220F	5	Room temperature	Unheated control	1.0	4.0	Pass	0.300	2.56×10^{14}	4.02×10^{14}	1,060
					1.0	2.5	Pass	0.700	2.73×10^{14}	9.29×10^{14}	165
					1.1	1.5	Pass	0.400	(avg.) 1.41×10^{14}	(avg.) 6.65×10^{14}	113
						(avg.) 2.3					(avg.) 446
				Three cycles of 40 hr at 300°F	1.5	4.0	Pass	0.400	(avg.) 7.13×10^{15}	(avg.) 7.74×10^{14}	400
					1.0	4.0	Pass	0.600			180
					1.0	2.0	Pass	0.300			1,500
						(avg.) 3.3					(avg.) 693
16	Hi-Heat Aluminum Paint 171-A-28	1	450	Unheated control	1.1	0.5	Fail	—	—	—	—
					1.0	0.5	Fail				
					1.0	0.5	Fail				
						(avg.) 0.5					
				Three cycles of 40 hr at 300°F	0.8	0.5	Pass	—	—	—	—
					0.8	0.5	Pass				
					0.8	0.5	Pass				
						(avg.) 0.5					
17	Insl-X U-86	1	Room temperature	Unheated control	2.0	1.5	Pass	1.500	1.35×10^{13}	1.93×10^{14}	1,033
		5	200		2.0	1.5	Pass	1.800	2.39×10^{13}	3.09×10^{14}	1,110
					2.5	1.5	Pass	1.800	1.75×10^{13}	2.32×10^{14}	1,750
						(avg.) 1.5			(avg.) 1.83×10^{13}	(avg.) 2.44×10^{14}	(avg.) 1,297
				Three cycles of 40 hr at 300°F	1.5	7.5	Pass	1.700	5.09×10^{14}	1.54×10^{14}	1,585
					1.75	7.5	Pass	1.800	7.98×10^{14}	7.74×10^{13}	1,583
					1.5	7.5	Pass	1.500	1.45×10^{15}	2.01×10^{14}	2,000
						(avg.) 7.5			(avg.) 9.19×10^{14}	(avg.) 1.44×10^{14}	(avg.) 1,722

Table B-2 (cont'd)

No. (Table 5)	Commercial designation	Cure schedule		Thermal exposure conditions	Mechanical properties			Electrical properties			
		Duration, hr	Temperature, °F		Thickness, mil	Scrape adhesion[a], kg	Flexibility[b] (cold cracking)	Thickness, mil	Volume resistivity[c] Ω-cm	Surface resistivity[c] Ω	Dielectric strength[c], v/mil
18	Interchemical 12412	72	Room temperature	Unheated control	1.0	5.0	Pass	0.5	1.33×10^{15}	7.74×10^{14}	300
					1.0	5.0	Pass	0.4	3.03×10^{15}	7.74×10^{14}	250
					1.0	5.0	Pass	0.5	1.81×10^{15}	7.74×10^{14}	300
						(avg.) 5.0			(avg.) 2.05×10^{15}	(avg.) 7.74×10^{14}	(avg.) 283
				Three cycles of 40 hr at 300°F	0.6	9.5	Pass	0.4	Shorted	Shorted	125
					0.5	>10.0	Pass	0.4	Shorted	Shorted	125
					0.5	>10.0	Pass	0.4	Shorted	Shorted	125
						(avg.) 9.9					(avg.) 125
20	Number 73-X Ink	24	Room temperature	Unheated control	1.0	<0.5	Pass	2.0	1.42×10^{10}	9.76×10^{13}	25
					1.0	<0.5	Pass	2.1	1.08×10^{10}	9.76×10^{13}	24
					1.0	<0.5	Pass	2.3	9.84×10^{9}	6.81×10^{13}	22
						(avg.) <0.5			(avg.) 1.16×10^{10}	(avg.) 8.77×10^{13}	(avg.) 24
				Three cycles of 40 hr at 300°F	1.0	1.5	Pass	2.5	5.62×10^{9}	2.47×10^{14}	20
					1.0	1.5	Pass	2.4	5.87×10^{9}	2.63×10^{14}	21
					1.0	1.5	Pass	2.3	8.61×10^{9}	6.19×10^{13}	22
						(avg.) 1.5			(avg.) 6.70×10^{9}	(avg.) 1.90×10^{14}	(avg.) 21
21	Number 445 Silicone Water Repellent	24	Room temperature	Unheated control	<0.1	1.5	Pass	—	—	—	—
					0.2	2.0	Pass				
					<0.1	2.0	Pass				
						(avg.) 1.8					
				Three cycles of 40 hr at 300°F	<0.1	1.0	Pass	—	—	—	—
					<0.1	1.0	Pass				
					<0.1	0.5	Pass				
						(avg.) 0.8					
22	Number 7576-#515	24	Room temperature	Unheated control	0.8	3.5	Pass	1.6	9.40×10^{13}	1.11×10^{14}	250
					1.0	3.5	Pass	1.6	7.23×10^{13}	1.45×10^{14}	270
					1.0	3.5	Pass	1.7	3.39×10^{13}	6.19×10^{13}	280
						(avg.) 3.5			(avg.) 6.67×10^{13}	(avg.) 1.05×10^{14}	(avg.) 266
				Three cycles of 40 hr at 300°F	0.9	4.5	Pass	1.0	2.0×10^{13}	2.8×10^{13}	150
					1.0	4.5	Pass	1.7	7.0×10^{13}	2.2×10^{13}	135
					1.0	4.5	Pass		(avg.) 4.50×10^{13}	(avg.) 2.50×10^{13}	(avg.) 142
						(avg.) 4.5					

Table B-2 (cont'd)

No. (Table 5)	Commercial designation	Cure schedule		Thermal exposure conditions	Mechanical properties			Electrical properties			
		Duration, hr	Temperature, °F		Thickness, mil	Scrape adhesion[a], kg	Flexibility[b] (cold cracking)	Thickness, mil	Volume resistivity[c] Ω-cm	Surface resistivity[c] Ω	Dielectric strength[c], v/mil
23	Perma-Dri Ink 177	24	Room temperature	Unheated control	0.1	<0.5	Pass	0.1	1.23×10^{10}	1.54×10^{7}	0
					0.3	<0.5	Pass	0.1	6.18×10^{9}	7.74×10^{6}	0
					0.2	<0.5	Pass	0.1	3.09×10^{9}	4.64×10^{6}	0
						(avg.) <0.5			(avg.) 7.20×10^{9}	(avg.) 9.23×10^{6}	(avg.) 0
				Three cycles of 40 hr at 300°F	0.2	2.5	Pass	0.1	7.73×10^{9}	3.87×10^{6}	0
					0.1	3.0	Pass	0.1	7.73×10^{9}	9.29×10^{6}	0
					0.2	4.5	Pass	0.1	3.09×10^{9}	1.54×10^{6}	0
						(avg.) 3.3			(avg.) 6.18×10^{9}	(avg.) 4.90×10^{6}	(avg.) 0
24	PR 1902	24	75	Unheated control	0.4	<0.5	Pass	0.8	(avg.) 2.76×10^{13}	4.64×10^{14}	550
					1.1	<0.5	Pass	0.8		1.85×10^{11}	410
					0.5	<0.5	Pass	0.8		(avg.) 3.24×10^{11}	320
						(avg.) <0.5					(avg.) 426
				Three cycles of 40 hr at 300°F	1.2	<0.5	Pass	0.8	(avg.) 1.86×10^{12}	1.17×10^{14}	500
					0.8	<0.5	Pass	0.8		2.94×10^{14}	460
					0.5	<0.5	Pass			(avg.) 2.05×10^{14}	(avg.) 480
						(avg.) <0.5					
25	Pyre-ML Varnish RK-692	1	220	Unheated control	0.5	2.5	Pass	0.4	7.50×10^{7}	2.78×10^{14}	375
		1	300		1.25	2.5	Pass	0.4	1.36×10^{12}	7.74×10^{14}	1,225
		1	420		1.0	4.5	Pass		(avg.) 6.85×10^{11}	(avg.) 5.26×10^{14}	(avg.) 800
						(avg.) 3.1					
				Three cycles of 40 hr at 300°F	1.1	3.5	Pass	0.3	1.01×10^{10}	1.54×10^{7}	430
					1.0	3.5	Pass	0.3	2.54×10^{15}	1.54×10^{12}	670
					1.0	3.0	Pass	0.3	1.01×10^{10}	1.54×10^{7}	670
						(avg.) 3.3			(avg.) 8.46×10^{14}	(avg.) 5.13×10^{11}	(avg.) 590
26	SR 290	24	Room temperature	Unheated control	0.5	1.0	Fail	1.1	7.50×10^{15}	1.08×10^{15}	55
					0.5	0.5	Fail	1.1	5.62×10^{15}	9.29×10^{14}	47
					0.5	1.5	Fail		(avg.) 6.56×10^{15}	(avg.) 1.00×10^{15}	(avg.) 51
						(avg.) 1.0					
				Three cycles of 40 hr at 300°F	0.5	1.0	Fail	1.5	(avg.) 1.93×10^{16}	(avg.) 3.09×10^{15}	(avg.) 900
					0.75	1.0	Fail				
						(avg.) 1.0	Fail				
29	Uralane 241/973	24	Room temperature	Unheated control	0.75	1.0	Pass	0.9	1.22×10^{16}	5.42×10^{14}	1,830
					1.5	0.5	Pass	0.9	4.95×10^{15}	2.78×10^{14}	2,600
						(avg.) 0.75	Pass	1.1	1.07×10^{16}	2.32×10^{14}	2,450
									(avg.) 9.20×10^{15}	(avg.) 3.50×10^{14}	(avg.) 2,293
				Three cycles of 40 hr at 300°F	1.0	3.0	Pass	0.8	5.59×10^{14}	7.74×10^{14}	3,000
					1.1	3.0	Pass	0.9	9.90×10^{14}	7.74×10^{14}	3,550
					1.3	5.0	Pass	1.5	5.80×10^{14}	4.64×10^{14}	(avg.) 3,275
						(avg.) 3.6			(avg.) 7.09×10^{14}	(avg.) 6.70×10^{11}	

Table B-3. Thermal sterilization test data for elastomers

No. (Table 6)	Commercial designation	Thermal exposure conditions	Mechanical properties							Electrical properties				Weight loss[e], %
			Shore hardness[a] A	Specimen dimensions, in.	Tensile strength[b], psi	Elongation[b], %	Compression set[c] t_0	Compression set[c] t_1	Compression set[c] % Compression set, $\frac{t_0-t_1}{t_0-t_s}\times 100$	Thickness, mil	Volume resistivity[d], Ω-cm	Surface resistivity[d], Ω	Dielectric strength[d], v/mil	
1	AMS 3195	Unheated control	11	0.135/0.062	125	265	0.475	0.460	15.000	125	1.45×10^{15}	8.52×10^{14}	184	
			10	0.135/0.062	130	270	0.436	0.424	19.672	130	2.82×10^{15}	8.52×10^{14}	200	
			13	0.134/0.062	130	275	0.451	0.445	7.895	110	3.25×10^{15}	1.00×10^{15}	240	
			(avg.) 11.3		(avg.) 130	(avg.) 270	(avg.) 0.454	(avg.) 0.443	(avg.) 14.189		(avg.) 2.50×10^{15}	(avg.) 9.01×10^{14}	(avg.) 208	
		Three cycles of 40 hr at 300°F	18	0.142/0.062	115	200	0.469	0.463	6.383	125	1.03×10^{14}	1.54×10^{14}	200	0.084
			14	0.143/0.062	150	240	0.484	0.480	3.670	111	1.57×10^{14}	1.39×10^{14}	252	0.087
			17	0.143/0.062	150	235	0.448	0.440	10.959	115	1.25×10^{14}	1.93×10^{14}	226	(avg.) 0.086
			(avg.) 16.5	0.142/0.062	155	240	(avg.) 0.467	(avg.) 0.461	(avg.) 7.004		(avg.) 1.28×10^{14}	(avg.) 1.62×10^{14}	(avg.) 226	
					(avg.) 140	(avg) 230								
2	B-318-7/70	Unheated control	73	0.126/0.062	1,540	295	0.511	0.480	22.794	126	3.47×10^{7}	2.63×10^{7}	<1	
			71	0.126/0.061	1,590	300	0.510	0.483	20.000	128	5.52×10^{7}	3.25×10^{7}	<1	
			71	0.126/0.062	1,560	280	0.508	0.482	19.549	128	3.42×10^{7}	2.94×10^{7}	<1	
			(avg.) 72.2		(avg.) 1,563	(avg.) 292	(avg.) 0.510	(avg.) 0.482	(avg.) 20.781		(avg.) 4.13×10^{7}	(avg.) 2.67×10^{7}	(avg.) <1	
		Three cycles of 40 hr at 300°F	65	0.125/0.062	1,280	235	0.504	0.480	18.605	124	3.91×10^{7}	3.40×10^{7}	4	2.169
			65	0.122/0.062	1,370	270	0.514	0.495	13.669	124	6.26×10^{7}	3.25×10^{7}	4	2.082
			66	0.124/0.062	1,450	290	(avg.) 0.509	(avg.) 0.490	(avg.) 16.137	124	6.06×10^{7}	2.78×10^{7}	9	2.199
			(avg.) 65.8	0.125/0.062	1,420	290					(avg.) 5.41×10^{7}	(avg.) 3.14×10^{7}	(avg.) 6	(avg.) 2.150
					(avg.) 1,380	(avg.) 271								
3	Butyl Rubber 805-70	Unheated control	72	0.136/0.064	1,510	355	0.514	0.455	42.446	120	2.01×10^{6}	1.39×10^{6}	7	
			67	0.134/0.064	1,535	365	0.546	0.463	48.538	120	2.61×10^{6}	2.01×10^{6}	8	
			73	0.133/0.064	1,545	385	0.534	0.462	45.283	126	3.08×10^{6}	2.32×10^{6}	7	
			(avg.) 71		(avg.) 1,530	(avg.) 370	(avg.) 0.531	(avg.) 0.460	(avg.) 45.422		(avg.) 2.53×10^{6}	(avg.) 1.90×10^{6}	(avg.) 7	
		Three cycles of 40 hr at 300°F	73	0.130/0.064	1,260	295	0.528	0.464	41.830	126	1.93×10^{6}	3.09×10^{5}	5	1.190
			76	0.130/0.064	1,310	310	0.528	0.465	41.176	127	5.75×10^{6}	1.70×10^{6}	5	1.139
			76	0.130/0.064	1,310	305	0.527	0.468	38.816		(avg.) 3.84×10^{6}	(avg.) 1.00×10^{6}	(avg.) 5	1.197
			(avg.) 75.3	0.128/0.064	1,280	300	(avg.) 0.527	(avg.) 0.465	(avg.) 40.607					(avg.) 1.175
					(avg.) 1,290	(avg.) 305								
4	Hadbar XB 800-71	Unheated control	46	0.055/0.065	1,650	760	0.484	0.448	33.028	58	3.05×10^{9}	3.71×10^{9}	55	
			50	0.050/0.065	1,890	650	0.492	0.451	35.043	56	3.89×10^{9}	9.91×10^{9}	42	
			45	0.045/0.065	1,710	730	(avg.) 0.487	(avg.) 0.449	(avg.) 34.035	52	6.66×10^{9}	8.67×10^{9}	42	
			(avg.) 47.3		(avg.) 1,750	(avg.) 713					(avg.) 4.53×10^{9}	(avg.) 7.42×10^{9}	(avg.) 46	
		Three cycles of 40 hr at 300°F	65	0.048/0.065	2,050	210	0.507	0.498	6.818	61	7.19×10^{7}	7.43×10^{7}	40	0.662
			65	0.050/0.065	2,200	210	0.526	0.517	5.960	52	1.09×10^{8}	8.67×10^{7}	100	0.666
			66	0.050/0.065	2,050	200	(avg.) 0.516	(avg.) 0.507	(avg.) 6.389	53	6.63×10^{7}	3.71×10^{7}	34	0.704
			(avg.) 65.5	0.050/0.065	1,920	190					(avg.) 8.24×10^{7}	(avg.) 6.60×10^{7}	(avg.) 58	(avg.) 0.677
					(avg.) 2,055	(avg.) 202								

[a]ASTM D676-59T. [b]ASTM D412-62T. [c]ASTM D395—61, Method B. [d]ASTM D257. [e]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

Table B-3 (cont'd)

No. (Table 6)	Commercial designation	Thermal exposure conditions	Mechanical properties							Electrical properties				Weight loss[c], %
			Shore hardness[a] A	Specimen dimensions, in.	Tensile strength[b], psi	Elongation[b], %	Compression set[c] t_0	Compression set[c] t_1	Compression set[c] % Compression set, $\frac{t_0-t_1}{t_0-t_s}\times 100$	Thickness, mil	Volume resistivity[d], Ω-cm	Surface resistivity[d], Ω	Dielectric strength[d], v/mil	
5	Hadbar 1000/80	Unheated control	75	0.133/0.062	715	120	0.519	0.497	14.667	125	2.72×10^{14}	4.18×10^{13}	352	
			75	0.132/0.062	700	115	0.524	0.502	14.194	124	3.32×10^{14}	7.28×10^{13}	377	
			75	0.127/0.062	750	125	0.532	0.510	13.497	125	3.30×10^{14}	7.74×10^{13}	354	
			(avg.) 75.3		(avg.) 722	(avg.) 120	(avg.) 0.525	(avg.) 0.503	(avg.) 14.119		(avg.) 3.11×10^{14}	(avg.) 6.40×10^{13}	(avg.) 361	
		Three cycles of 40 hr at 300°F	77	0.129/0.063	645	85	0.517	0.492	17.007	132	8.35×10^{11}	6.04×10^{12}	337	0.877
			77	0.132/0.063	720	100	0.525	0.496	18.125	126	1.44×10^{12}	8.36×10^{12}	342	0.800
			77	0.130/0.063	795	115	0.519	0.491	18.182	126	2.12×10^{13}	1.16×10^{13}	365	0.802
			(avg.) 77.5		(avg.) 720	(avg.) 100	(avg.) 0.520	(avg.) 0.493	(avg.) 17.771		(avg.) 1.46×10^{13}	(avg.) 8.66×10^{12}	(avg.) 348	(avg.) 0.826
6	Hadbar 4000/80	Unheated control	68	0.138/0.064	760	210	0.510	0.498	8.889	143	5.02×10^{14}	4.95×10^{14}	350	
			68	0.140/0.064	785	220	0.523	0.510	8.784	136	6.69×10^{14}	7.43×10^{14}	368	
			(avg.) 68.2	0.136/0.064	830	240	(avg.) 0.516	(avg.) 0.504	(avg.) 8.836	130	6.01×10^{14}	6.97×10^{14}	385	
					(avg.) 790	(avg.) 225					(avg.) 5.90×10^{14}	(avg.) 6.45×10^{14}	(avg.) 367	
		Three cycles of 40 hr at 300°F	71	0.140/0.063	760	145	0.514	0.503	7.914	136	1.12×10^{13}	4.95×10^{12}	360	0.474
			71	0.137/0.062	975	200	0.513	0.503	7.246	135	7.10×10^{12}	2.16×10^{13}	363	0.407
			72	0.141/0.063	710	140	(avg.) 0.513	(avg.) 0.503	(avg.) 7.580	136	9.40×10^{12}	2.16×10^{14}	368	0.314
			(avg.) 71.3	0.140/0.063	645	120					(avg.) 9.23×10^{12}	(avg.) 9.57×10^{13}	(avg.) 363	(avg.) 0.398
					(avg.) 770	(avg.) 150								
7	Hadbar 5000/50	Unheated control	45	0.118/0.062	820	550	0.498	0.487	8.943	130	1.44×10^{13}	8.05×10^{13}	385	
			46	0.122/0.062	825	570	0.485	0.473	10.909	121	1.69×10^{13}	8.98×10^{13}	413	
			45	0.120/0.062	770	545	0.496	0.483	10.744	129	1.79×10^{13}	6.04×10^{13}	387	
			(avg.) 45.3		(avg.) 805	(avg.) 555	(avg.) 0.493	(avg.) 0.481	(avg.) 10.199		(avg.) 1.64×10^{13}	(avg.) 7.69×10^{12}	(avg.) 395	
		Three cycles of 40 hr at 300°F	52	0.122/0.062	825	465	0.481	0.468	11.320	121	1.79×10^{13}	7.74×10^{12}	413	0.185
			51	0.126/0.062	830	480	0.493	0.477	13.559	120	2.21×10^{13}	1.16×10^{13}	417	0.141
			51	0.122/0.062	825	460	0.483	0.468	13.889	121	2.59×10^{13}	2.32×10^{13}	413	0.187
			(avg.) 51.5	0.126/0.062	830	455	(avg.) 0.486	(avg.) 0.471	(avg.) 12.923		(avg.) 2.19×10^{13}	(avg.) 1.41×10^{13}	(avg.) 414	(avg.) 0.171
					(avg.) 830	(avg.) 465								

Table B-3 (cont'd)

No. (Table 6)	Commercial designation	Thermal exposure conditions	Mechanical properties							Electrical properties				Weight loss[e], %
			Shore hardness[a] A	Specimen dimensions, in.	Tensile strength[b], psi	Elongation[b], %	Compression set[c]			Thickness, mil	Volume resistivity[d], Ω-cm	Surface resistivity[d], Ω	Dielectric strength[d], v/mil	
							t_0	t_1	% Compression set, $\frac{t_0-t_1}{t_0-t_s}\times 100$					
8	L-308-80	Unheated control	48	0.060/0.062	700	170	—	—	—	59	1.87×10^{14}	4.02×10^{14}	313	
			49	0.060/0.062	750	170				61	3.24×10^{14}	3.40×10^{14}	304	
			50	0.059/0.062	860	200				59	2.11×10^{14}	6.04×10^{14}	314	
			(avg.) 49.2		(avg.) 770	(avg.) 180					(avg.) 2.44×10^{14}	(avg.) 4.48×10^{14}	(avg.) 310	
		Three cycles of 40 hr at 300°F	47	0.055/0.062	910	210	—	—	—	61	6.87×10^{12}	1.54×10^{13}	553	0.636
			47	0.060/0.062	780	185				64	9.41×10^{12}	1.85×10^{13}	508	0.558
			47	0.058/0.062	805	200				62	7.90×10^{12}	2.16×10^{13}	540	0.621
			(avg.) 47.5		(avg.) 830	(avg.) 198					(avg.) 8.06×10^{12}	(avg.) 1.85×10^{13}	(avg.) 533	(avg.) 0.606
9	L-449-6/60	Unheated control	50	0.058/0.062	890	185	0.531	0.521	5.917	57	8.46×10^{13}	5.26×10^{14}	336	
			50	0.058/0.062	1,030	210	0.532	0.523	5.357	57	1.27×10^{14}	2.63×10^{14}	330	
			51	0.058/0.062	875	185	(avg.) 0.531	(avg.) 0.522	(avg.) 5.637	57	8.08×10^{13}	3.25×10^{14}	327	
			(avg.) 50.5		(avg.) 930	(avg.) 195					(avg.) 9.74×10^{13}	(avg.) 3.71×10^{14}	(avg.) 331	
		Three cycles of 40 hr at 300°F	48	0.056/0.062	750	170	0.535	0.519	10.000	57	1.74×10^{12}	1.47×10^{13}	490	0.680
			49	0.056/0.062	835	185	0.534	0.518	9.816	58	1.47×10^{12}	1.16×10^{13}	520	0.410
			49	0.058/0.062	790	190	(avg.) 0.534	(avg.) 0.518	(avg.) 9.908	55	2.16×10^{12}	3.09×10^{13}	530	0.462
			(avg.) 48.7	0.055/0.062	995	210					(avg.) 1.79×10^{12}	(avg.) 1.90×10^{13}	(avg.) 513	(avg.) 0.517
					(avg.) 840	(avg.) 190								
10	N-195-7/70	Unheated control	67	0.150/0.062	2,795	360	0.443	0.436	10.150	173	5.90×10^{9}	7.43×10^{10}	83	
			68	0.146/0.062	2,760	365	0.486	0.474	10.526	173	5.16×10^{9}	1.44×10^{11}	87	
			69	0.146/0.062	2,870	365	0.438	0.431	10.606	165	6.29×10^{9}	2.44×10^{11}	91	
			(avg.) 68.1		(avg.) 2,810	(avg.) 365	0.508	0.497	8.148		(avg.) 5.78×10^{9}	(avg.) 1.54×10^{11}	(avg.) 87	
							(avg.) 0.469	(avg.) 0.460	(avg.) 9.858					
		Three cycles of 40 hr at 300°F	72	0.146/0.062	2,815	220	0.492	0.480	9.375	187	3.58×10^{9}	5.57×10^{10}	70	1.470
			73	0.144/0.062	2,465	200	0.473	0.462	10.680	153	5.40×10^{9}	1.31×10^{11}	95	1.432
			73	0.146/0.062	3,095	245	0.491	0.479	10.084	193	5.50×10^{9}	1.39×10^{11}	79	1.549
			(avg.) 73.0	0.150/0.062	2,955	255	0.492	0.480	9.756		(avg.) 4.82×10^{9}	(avg.) 1.08×10^{11}	(avg.) 81	(avg.) 1.483
					(avg.) 2,830	(avg.) 230	(avg.) 0.487	(avg.) 0.475	(avg.) 9.974					

Table B-3 (cont'd)

No. (Table 6)	Commercial designation	Thermal exposure conditions	Mechanical properties: Shore hardness[a] A	Specimen dimensions, in.	Tensile strength[b], psi	Elongation[b], %	Compression set[c]: t_0	t_1	% Compression set, $\frac{t_0-t_1}{t_0-t_s}\times 100$	Electrical properties: Thickness, mil	Volume resistivity[d], Ω-cm	Surface resistivity[d], Ω	Dielectric strength[d], v/mil	Weight loss[e], %
12	PMP 6035	Unheated control	67	0.121/0.061	865	250	0.491	0.480	11.290	121	1.99×10^{15}	1.23×10^{15}	413	
			68	0.122/0.061	865	245	0.499	0.485	11.207	120	1.20×10^{15}	9.29×10^{14}	418	
			68	0.122/0.062	830	240	0.491	0.478	9.483	121	1.79×10^{15}	7.74×10^{14}	413	
			(avg.) 68.0	0.122/0.061	645 (avg.) 800	245 (avg.) 245	(avg.) 0.494	(avg.) 0.481	(avg.) 10.660		(avg.) 1.66×10^{15}	(avg.) 9.77×10^{14}	(avg.) 414	
		Three cycles of 40 hr at 300°F	63	0.122/0.062	960	215	0.489	0.477	10.526	120	2.00×10^{14}	1.54×10^{14}	415	(avg.) 0.000
			64	0.123/0.062	930	205	0.498	0.486	9.756	123	3.94×10^{14}	1.54×10^{14}	407	
			64	0.121/0.061	970	180	0.494	0.481	10.924	122	1.77×10^{14}	1.23×10^{14}	409	
			(avg.) 63.8		(avg.) 885	(avg.) 200	(avg.) 0.494	(avg.) 0.481	(avg.) 10.402		(avg.) 2.57×10^{14}	(avg.) 1.43×10^{14}	(avg.) 410	
13	PMP 6100	Unheated control	45	0.124/0.062	553	395	0.495	0.490	4.167	121	2.09×10^{15}	1.78×10^{14}	375	
			44	0.123/0.062	715	520	0.492	0.486	5.128	125	3.88×10^{15}	6.97×10^{14}	375	
			45	0.122/0.062	687	515	0.488	0.483	4.425	123	1.45×10^{15}	2.94×10^{14}	375	
			(avg.) 44.9		(avg.) 652	(avg.) 475	(avg.) 0.492	(avg.) 0.486	(avg.) 4.573		(avg.) 2.47×10^{15}	(avg.) 3.89×10^{14}	(avg.) 375	
		Three cycles of 40 hr at 300°F	47	0.126/0.062	725	460	0.492	0.486	5.128	121	6.59×10^{13}	1.54×10^{13}	396	0.363
			48	0.123/0.062	615	400	0.491	0.484	6.034	121	7.79×10^{13}	3.40×10^{13}	413	0.292
			48	0.124/0.062	560	340	0.494	0.488	5.042	122	9.92×10^{13}	6.19×10^{13}	394	0.402
			(avg.) 48.8		(avg.) 633	(avg.) 400	(avg.) 0.492	(avg.) 0.486	(avg.) 5.401		(avg.) 8.10×10^{13}	(avg.) 3.71×10^{13}	(avg.) 401	(avg.) 0.352
14	RC-5 No. 1852	Unheated control	57	0.037/0.068	1,990	255	—	—	—	35	6.46×10^{8}	1.16×10^{9}	67	
			57	0.039/0.068	1,940	250				35	6.09×10^{8}	4.02×10^{8}	64	
			57	0.037/0.068	2,130	250				35	7.61×10^{8}	1.31×10^{9}	62	
			(avg.) 57.0	0.037/0.068	(avg.) 2,020	(avg.) 252					(avg.) 6.72×10^{8}	(avg.) 9.56×10^{8}	(avg.) 64	
		Three cycles of 40 hr at 300°F	70	0.036/0.069	2,270	140	—	—	—	34	8.29×10^{9}	2.01×10^{9}	20	1.820
			71	0.036/0.069	2,380	150				34	6.30×10^{9}	3.87×10^{9}	19	1.774
			72	0.036/0.068	2,040	145				35	4.32×10^{9}	3.07×10^{9}	19	1.918
			(avg.) 71.3	0.036/0.068	2,000 (avg.) 2,172	135 (avg.) 142					(avg.) 6.30×10^{9}	(avg.) 2.99×10^{9}	(avg.) 19	(avg.) 1.837

Table B-3 (cont'd)

No. (Table 6)	Commercial designation	Thermal exposure conditions	Mechanical properties							Electrical properties				Weight loss[e], %
			Shore hardness[a] A	Specimen dimensions, in.	Tensile strength[b], psi	Elongation[b], %	Compression set[c] t_0	Compression set[c] t_1	Compression set[c] % Compression set, $\frac{t_0-t_1}{t_0-t_s}\times 100$	Thickness, mil	Volume resistivity[d], Ω-cm	Surface resistivity[d], Ω	Dielectric strength[d], v/mil	
15	RC-5 Silicone	Unheated control	46	0.068/0.068	1,440	530	—	—	—	53	4.98×10^{13}	2.32×10^{15}	720	
			46	0.070/0.065	1,350	480				54	5.30×10^{13}	1.85×10^{15}	760	
			45	0.070/0.066	1,280	465				58	3.78×10^{13}	2.32×10^{15}	735	
			(avg.) 46.0	0.071/0.067	1,210	460					(avg.) 4.68×10^{13}	(avg.) 2.16×10^{15}	(avg.) 738	
					(avg.) 1,320	(avg.) 484								
		Three cycles of 40 hr at 300°F	49	0.070/0.065	1,320	420	—	—	—	58	1.89×10^{14}	1.54×10^{15}	735	0.472
			49	0.071/0.064	1,350	440				56	2.36×10^{14}	2.32×10^{15}	820	0.402
			48	0.071/0.064	1,240	400					(avg.) 2.12×10^{14}	(avg.) 1.93×10^{15}	(avg.) 777	0.547
			(avg.) 48.8	0.071/0.065	1,330	450								(avg.) 0.473
					(avg.) 1,310	(avg.) 428								
16	RTV 501	Unheated control	40	0.087/0.060	315	185	—	—	—	91	4.33×10^{13}	6.19×10^{13}	420	
			38	0.083/0.061	285	165				91	2.29×10^{13}	5.26×10^{13}	395	
			40	0.083/0.061	330	175				89	2.86×10^{13}	1.85×10^{13}	450	
			(avg.) 39.3		(avg. 310	(avg.) 175					(avg.) 3.16×10^{13}	(avg.) 4.43×10^{13}	(avg.) 422	
		Three cycles of 40 hr at 300°F	28	0.081/0.060	205	165	—	—	—	84	5.20×10^{12}	3.09×10^{13}	450	1.787
			28	0.085/0.060	215	200				85	8.66×10^{12}	2.78×10^{13}	480	1.781
			29	0.085/0.060	215	195				90	8.24×10^{12}	2.16×10^{13}	470	1.809
			(avg.) 28.5	0.086/0.061	210	200					(avg.) 7.37×10^{12}	(avg.) 2.68×10^{13}	(avg.) 467	(avg.) 1.793
					(avg.) 210	(avg.) 190								
17	RTV 615 A/B	Unheated control	21	0.087/0.062	200	175	—	—	—	94	1.61×10^{14}	1.00×10^{15}	405	
			22	0.090/0.062	70	125				95	9.83×10^{14}	1.54×10^{15}	445	
			22	0.091/0.062	90	120				96	8.04×10^{13}	1.54×10^{15}	484	
			(avg.) 21.8		(avg.) 120	(avg.) 140					(avg.) 4.08×10^{14}	(avg.) 1.36×10^{15}	(avg.) 444	
		Three cycles of 40 hr at 300°F	27	0.088/0.062	100	100	—	—	—	89	1.32×10^{14}	1.70×10^{14}	495	0.331
			28	0.091/0.062	180	125				91	1.40×10^{14}	8.52×10^{13}	506	0.273
			29	0.090/0.062	150	130				95	2.82×10^{14}	1.85×10^{14}	495	0.321
			(avg.) 28.2		(avg.) 145	(avg.) 120					(avg.) 1.85×10^{14}	(avg.) 1.47×10^{14}	(avg.) 499	(avg.) 0.308

Table B-3 (cont'd)

No. (Table 6)	Commercial designation	Thermal exposure conditions	Mechanical properties							Electrical properties				Weight loss[e], %
			Shore hardness[a] A	Specimen dimensions, in.	Tensile strength[b], psi	Elongation[b], %	Compression set[c]			Thickness, mil	Volume resistivity[d], Ω-cm	Surface resistivity[d], Ω	Dielectric strength[d], v/mil	
							t_0	t_1	% Compression set, $\frac{t_0-t_1}{t_0-t_s}\times 100$					
18	Rubber 1814	Unheated control	67	0.085/0.062	210	495	0.439	0.425	21.875	88	8.89×10^{5}	5.11×10^{5}	2	
			67	0.085/0.062	210	495	0.460	0.433	31.765	88	1.96×10^{6}	1.16×10^{6}	2	
			68	0.085/0.062	210	530	0.448	0.428	27.397		(avg.) 1.43×10^{6}	(avg.) 8.36×10^{5}	(avg.) 2	
			(avg.) 67.5		(avg.) 210	(avg.) 505	(avg.) 0.449	(avg.) 0.429	(avg.) 27.012					
		Three cycles of 40 hr at 300°F	65	0.087/0.060	110	490	0.438	0.395	68.254	90	7.21×10^{5}	7.74×10^{5}	10	1.631
			63	0.083/0.060	115	520	0.445	0.398	67.143	89	5.17×10^{5}	3.71×10^{5}	11	1.397
			65	0.087/0.060	105	460	0.438	0.397	65.079	87	1.11×10^{6}	6.97×10^{5}	12	1.458
			(avg.) 64.5	0.087/0.061	110	520	(avg.) 0.440	(avg.) 0.397	(avg.) 66.825		(avg.) 7.82×10^{5}	(avg.) 6.14×10^{5}	(avg.) 12	(avg.) 1.495
					(avg.) 110	(avg.) 495								
19	S-417-7	Unheated control	66	0.128/0.063	890	295	0.494	0.481	10.924	123	8.64×10^{14}	6.97×10^{14}	405	
			66	0.127/0.063	810	270	0.497	0.484	10.656	120	1.50×10^{15}	1.85×10^{14}	415	
			66	0.128/0.062	940	305	0.493	0.479	11.864	125	1.06×10^{15}	3.09×10^{14}	399	
			(avg.) 66.3	0.128/0.062	910	295	(avg.) 0.495	(avg.) 0.481	(avg.) 11.148		(avg.) 1.14×10^{15}	(avg.) 3.97×10^{14}	(avg.) 407	
					(avg.) 885	(avg.) 290								
		Three cycles of 40 hr at 300°F	64	0.127/0.063	425	130	0.496	0.484	9.917	122	1.19×10^{14}	8.52×10^{13}	410	0.111
			64	0.127/0.064	540	160	0.493	0.480	11.017	125	1.74×10^{11}	6.50×10^{13}	399	0.092
			64	0.125/0.063	495	150	0.492	0.479	11.111	122	2.96×10^{11}	9.76×10^{13}	408	0.066
			(avg.) 64.3	0.128/0.063	570	175	(avg.) 0.494	(avg.) 0.481	(avg.) 10.682		(avg.) 1.96×10^{14}	(avg.) 8.26×10^{13}	(avg.) 405	(avg.) 0.090
					(avg.) 507	(avg.) 154								
20	Silastic 1410 (Heat Shrinkable)	Unheated control		Transverse:	1,055	400								
				0.134/0.495	1,045	390								
				0.133/0.490	(avg.) 1,050	(avg.) 395								
			48	Longitudinal:	1,170	410	0.423	0.414	18.750	112	2.66×10^{14}	1.54×10^{15}	446	
			49	0.470/0.116	1,260	490	0.436	0.423	21.311	111	3.76×10^{14}	1.16×10^{15}	405	
			50	0.480/0.126	1,480	460	(avg.) 0.429	(avg.) 0.418	(avg.) 20.030	114	5.25×10^{14}	1.93×10^{15}	439	
			(avg.) 49.0	0.478/0.116	(avg.) 1,303	(avg.) 475					(avg.) 3.89×10^{14}	(avg.) 1.54×10^{15}	(avg.) 430	
		Three cycles of 40 hr at 300°F		Transverse:	1,225	350								
				0.111/0.485	1,190	360								
				0.111/0.485	(avg.) 1,210	(avg.) 355								
			49	Longitudinal:	1,340	390	0.456	0.433	28.395	116	9.32×10^{14}	3.87×10^{15}	430	0.242
			49	0.460/0.123	1,430	430	0.465	0.441	26.667	119	1.31×10^{15}	2.32×10^{15}	420	0.231
			54	0.487/0.115	1,450	410	0.448	0.429	26.027	108	2.20×10^{15}	1.93×10^{15}	463	0.227
			(avg.) 50.8	0.486/0.116	(avg.) 1,407	(avg.) 410	(avg.) 0.450	(avg.) 0.434	(avg.) 27.030		(avg.) 1.48×10^{15}	(avg.) 2.71×10^{15}	(avg.) 438	(avg.) 0.233

Table B-3 (cont'd)

No. (Table 6)	Commercial designation	Thermal exposure conditions	Mechanical properties							Electrical properties				Weight loss[c], %
			Shore hardness[a] A	Specimen dimensions, in.	Tensile strength[b], psi	Elongation[b], %	Compression set[c] t_0	Compression set[c] t_1	Compression set[c] % Compression set, $\frac{t_0-t_1}{t_0-t_s}\times 100$	Thickness, mil	Volume resistivity[d], Ω-cm	Surface resistivity[d], Ω	Dielectric strength[d], v/mil	
21	Silicone Rubber 1050-70	Unheated control	72	0.142/0.062	850	240	0.571	0.556	7.653	120	3.62×10^{12}	1.39×10^{13}	417	
			73	0.143/0.062	845	235	0.569	0.553	8.247	126	3.47×10^{12}	2.47×10^{13}	397	
			73	0.139/0.062	810	225	0.568	0.554	7.254	124	3.13×10^{12}	3.87×10^{13}	403	
			(avg.) 73.0		(avg.) 835	(avg.) 235	(avg.) 0.569	(avg.) 0.554	(avg.) 7.718		(avg.) 3.41×10^{12}	(avg.) 2.58×10^{13}	(avg.) 406	
		Three cycles of 40 hr at 300°F	76	0.137/0.062	825	185	0.550	0.533	9.714	126	1.11×10^{12}	1.70×10^{13}	397	0.877
			75	0.142/0.062	850	195	0.565	0.548	8.947	123	1.12×10^{12}	1.93×10^{13}	407	0.866
			75	0.135/0.062	835	200	0.554	0.538	8.939	125	1.12×10^{12}	1.39×10^{13}	400	0.862
			(avg.) 75.3	0.143/0.062	845	190	(avg.) 0.556	(avg.) 0.540	(avg.) 9.200		(avg.) 1.12×10^{12}	(avg.) 1.67×10^{13}	(avg.) 401	(avg.) 0.868
					(avg.) 840	(avg.) 190								
22	Silicone Sheet 391-5	Unheated control	56	0.123/0.062	525	195	0.475	0.470	5.000	118	1.67×10^{14}	4.33×10^{13}	424	
			58	0.120/0.062	515	195	0.479	0.474	4.808	120	3.32×10^{14}	4.02×10^{13}	417	
			58	0.121/0.062	575	200	0.480	0.474	5.714	118	2.04×10^{14}	3.71×10^{13}	424	
			(avg.) 57.3	0.121/0.062	525	195	(avg.) 0.478	(avg.) 0.473	(avg.) 5.104		(avg.) 2.34×10^{14}	(avg.) 4.02×10^{13}	(avg.) 422	
					(avg.) 535	(avg.) 195								
		Three cycles of 40 hr at 300°F	61	0.118/0.062	650	150	0.480	0.472	7.619	116	6.83×10^{13}	6.04×10^{13}	430	0.111
			62	0.119/0.062	730	155	0.480	0.472	7.619	118	9.79×10^{13}	4.33×10^{13}	424	0.068
			62	0.117/0.062	550	125	0.482	0.475	6.542	117	1.33×10^{14}	2.32×10^{13}	410	0.119
			(avg.) 62.2	0.121/0.062	765	165	(avg.) 0.481	(avg.) 0.473	(avg.) 7.260		(avg.) 9.98×10^{13}	(avg.) 4.23×10^{13}	(avg.) 421	(avg.) 0.099
					(avg.) 675	(avg.) 150								
24	SR-613-75	Unheated control	75	0.122/0.063	1,905	240	—	—	—	130	1.59×10^{4}	1.23×10^{4}	<1	
			77	0.124/0.064	1,825	220				126	9.65×10^{3}	6.66×10^{3}	<1	
			75	0.124/0.062	1,855	225				127	1.34×10^{4}	1.08×10^{4}	<1	
			(avg.) 75.7		(avg.) 1,860	(avg.) 230					(avg.) 1.30×10^{4}	(avg.) 9.92×10^{3}	(avg.) <1	
		Three cycles of 40 hr at 300°F	76	0.127/0.062	1,510	295	—	—	—	125	1.06×10^{5}	5.42×10^{4}	1	1.294
			76	0.125/0.062	1,310	255				126	3.86×10^{4}	2.01×10^{4}	<1	1.267
			76	0.125/0.062	1,550	290				125	5.44×10^{4}	6.97×10^{4}	2	1.332
			(avg.) 76.0	0.125/0.062	1,535	310					(avg.) 6.63×10^{4}	(avg.) 4.80×10^{4}	(avg.) 1	(avg.) 1.298
					(avg.) 1,475	(avg.) 290								

Table B-3 (cont'd)

No. (Table 6)	Commercial designation	Thermal exposure conditions	Mechanical properties: Shore hardness[a] A	Specimen dimensions, in.	Tensile strength[b], psi	Elongation[b], %	Compression set[c]: t_0	t_1	% Compression set, $\frac{t_0-t_1}{t_0-t_2}\times 100$	Electrical properties: Thickness, mil	Volume resistivity[d], Ω-cm	Surface resistivity[d], Ω	Dielectric strength[d], v/mil	Weight loss[e], %
25	Viton B 60	Unheated control	70	0.128/0.062	2,395	360	0.508	0.471	27.820	130	7.52×10^{13}	2.01×10^{14}	158	
			70	0.129/0.062	2,345	345	0.508	0.469	29.323	131	7.09×10^{13}	2.01×10^{14}	161	
			70	0.129/0.062	2,375	345	0.506	0.468	29.008	128	4.76×10^{13}	3.56×10^{14}	156	
			(avg.) 70.5		(avg.) 2,370	(avg.) 350	(avg.) 0.507	(avg.) 0.469	(avg.) 28.717		(avg.) 6.46×10^{13}	(avg.) 2.53×10^{14}	(avg.) 158	
		Three cycles of 40 hr at 300°F	70	0.128/0.062	1,890	345	0.507	0.477	22.727	124	1.95×10^{13}	3.40×10^{13}	145	0.115
			70	0.127/0.062	1,715	220	0.517	0.484	23.239	131	2.24×10^{13}	1.31×10^{12}	160	0.083
			71	0.127/0.062	1,905	245	0.507	0.477	22.727	129	1.70×10^{13}	5.42×10^{12}	151	0.092
			(avg.) 70.7	0.128/0.062	1,825	230	(avg.) 0.510	(avg.) 0.479	(avg.) 22.898		(avg.) 1.96×10^{13}	(avg.) 3.38×10^{13}	(avg.) 152	(avg.) 0.097
					(avg.) 1,835	(avg.) 260								
26	Viton B 95	Unheated control	92	0.129/0.062	2,280	115	0.513	0.468	32.609	123	5.91×10^{14}	5.42×10^{14}	252	
			93	0.129/0.062	2,595	130	0.519	0.465	37.500	126	6.75×10^{14}	4.95×10^{14}	246	
			92	0.127/0.062	2,445	120	0.509	0.464	33.582	128	7.62×10^{14}	4.64×10^{14}	219	
			(avg.) 92.8		(avg.) 2,440	(avg.) 120	(avg.) 0.514	(avg.) 0.466	(avg.) 34.564		(avg.) 6.76×10^{14}	(avg.) 5.00×10^{14}	(avg.) 239	
		Three cycles of 40 hr at 300°F	96	0.130/0.062	2,080	100	0.518	0.470	33.566	125	8.74×10^{13}	1.00×10^{14}	256	0.136
			91	0.123/0.062	2,000	100	0.525	0.469	37.333	125	1.45×10^{14}	1.85×10^{14}	248	0.162
			91	0.130/0.062	1,610	85	(avg.) 0.521	(avg.) 0.469	(avg.) 35.449	126	1.06×10^{14}	1.85×10^{14}	310	0.150
			(avg.) 92.7	0.124/0.062	2,275	105					(avg.) 1.13×10^{14}	(avg.) 1.57×10^{14}	(avg.) 271	(avg.) 0.150
					(avg.) 1,990	(avg.) 100								
27	Viton 77-545	Unheated control	73	0.132/0.062	2,320	250	0.537	0.496	25.309	130	1.88×10^{12}	5.57×10^{12}	145	
			72	0.134/0.062	2,286	250	0.550	0.508	24.000	138	1.69×10^{12}	1.47×10^{13}	123	
			73	0.130/0.062	1,925	220	0.525	0.487	24.051		(avg.) 1.78×10^{12}	(avg.) 1.01×10^{13}	(avg.) 134	
			(avg.) 72.8		(avg.) 2,175	(avg.) 240	(avg.) 0.533	(avg.) 0.500	(avg.) 24.453					
		Three cycles of 40 hr at 300°F	73	0.125/0.062	2,020	230	0.527	0.495	21.711	137	2.15×10^{12}	1.08×10^{13}	126	0.126
			71	0.133/0.062	1,930	210	0.537	0.504	20.370	140	2.03×10^{12}	8.21×10^{12}	129	0.106
			73	0.137/0.062	1,825	170	0.536	0.502	21.118		(avg.) 2.09×10^{12}	(avg.) 9.50×10^{12}	(avg.) 127	0.163
			(avg.) 72.5	0.136/0.062	2,120	210	(avg.) 0.533	(avg.) 0.497	(avg.) 21.066					(avg.) 0.131
					(avg.) 1,975	(avg.) 205								

Table B-4. Thermal sterilization test data for encapsulants

No. (Table 8)	Commercial designation	Cure schedule for unheated controls		Thermal exposure conditions	Shore hardness[a]	Electrical properties				Physical and thermal properties		
		Duration, hr	Temperature, °F			Thickness, mil	Volume resistivity[b], Ω-cm	Surface resistivity[b], Ω	Dielectric strength[b], v/mil	Specific gravity[c]	Weight loss[d], %	Volume shrinkage[e], %
4	Eccosil 5000	24	Room temperature	Unheated control	57 A	169.0	1.32×10^{14}	8.21×10^{14}	70	0.550		
					56 A	463.0	2.16×10^{14}	4.80×10^{14}	76	0.556		
		2	250		56 A	492.0	1.46×10^{14}	3.71×10^{14}	51	(avg.) 0.553		
					(avg.) 56.3 A		(avg.) 1.65×10^{14}	(avg.) 6.11×10^{13}	(avg.) 66			
				Three cycles of 40 hr at 300°F	55 A	209.0	1.28×10^{14}	5.42×10^{14}	72	0.561	1.833	4.71
					53 A	425.0	1.07×10^{14}	2.47×10^{14}	61	0.557	1.961	2.91
					54 A	453.0	1.13×10^{14}	2.94×10^{14}	88	(avg.) 0.559	2.058	(avg.) 3.81
					(avg.) 54 A		(avg.) 1.16×10^{14}	(avg.) 3.61×10^{14}	(avg.) 74		(avg.) 1.951	
5	Epocast 202/9615	48	75	Unheated control	74 D	137.0	4.67×10^{14}	2.63×10^{15}	365	1.104		
					74 D	137.0	5.34×10^{14}	2.32×10^{15}	377	1.108		
					74 D	137.0	9.23×10^{14}	2.32×10^{15}	385	1.108		
					(avg.) 74 D		(avg.) 6.41×10^{14}	(avg.) 2.42×10^{15}	(avg.) 376	(avg.) 1.107		
				Three cycles of 40 hr at 300°F	82 D	127.0	3.45×10^{15}	3.09×10^{15}	394	1.118	6.847	6.01
					83 D	136.0	2.71×10^{15}	3.87×10^{15}	368	1.113	6.954	7.00
					81 D	130.0	2.63×10^{14}	4.64×10^{15}	385	1.114	6.689	(avg.) 6.51
					(avg.) 82 D		(avg.) 2.14×10^{15}	(avg.) 3.87×10^{15}	(avg.) 382	(avg.) 1.115	(avg.) 6.829	
6	Epocast 212/951	24	75	Unheated control	84 D	126.0	1.93×10^{15}	4.64×10^{15}	397	1.168		
					84 D	127.0	2.68×10^{15}	3.09×10^{15}	394	1.168		
					84 D	127.0	3.45×10^{15}	3.09×10^{15}	394	1.169		
					(avg.) 84 D		(avg.) 2.69×10^{15}	(avg.) 3.61×10^{15}	(avg.) 395	(avg.) 1.168		
				Three cycles of 40 hr at 300°F	84 D	129.0	1.89×10^{15}	2.32×10^{15}	388	1.174	0.578	0.77
					84 D	127.0	2.30×10^{15}	2.78×10^{15}	394	1.168	0.569	0.79
					85 D	127.0	2.68×10^{15}	2.63×10^{15}	394	1.162	0.579	0.78
					(avg.) 84.3 D		(avg.) 2.29×10^{15}	(avg.) 2.58×10^{15}	(avg.) 392	(avg.) 1.168	(avg.) 0.575	(avg.) 0.77
7	Hapex 1200A/Hardener 1210	2	180	Unheated control	Rockwell:	88.1	1.83×10^{15}	3.25×10^{14}	295	1.191		
					H60	88.3	2.30×10^{15}	3.25×10^{14}	265	1.189		
					H62	88.4	2.56×10^{15}	4.18×10^{14}	290	1.190		
					H61		(avg.) 2.23×10^{15}	(avg.) 3.65×10^{14}	(avg.) 283	(avg.) 1.190		
					(avg.) H61.0							
				Three cycles of 40 hr at 300°F	Rockwell:	84.3	6.00×10^{14}	2.01×10^{14}	595	1.192	4.100	6.03
					H56	83.8	1.43×10^{14}	1.85×10^{14}	595	1.184	3.940	4.36
					H58	85.5	4.31×10^{14}	3.40×10^{14}	585	1.182	3.910	(avg.) 5.15
					H58		(avg.) 3.91×10^{14}	(avg.) 2.42×10^{14}	(avg.) 592	(avg.) 1.186	(avg.) 3.980	
					(avg.) H57.5							

[a]ASTM D676—59T. [b]ASTM D257. [c]FTMS #406, Method 5011. [d]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg. [e]Volume measurements determined using Ames Micrometer Dial Gage, accurate to ±0.1 mil.

Table B-4 (cont'd)

No. (Table 8)	Commercial designation	Cure schedule for unheated controls		Thermal exposure conditions	Shore hardness[a]	Electrical properties				Physical and thermal properties		
		Duration, hr	Temperature, °F			Thickness, mil	Volume resistivity[b], Ω-cm	Surface resistivity[b], Ω	Dielectric strength[b], v/mil	Specific gravity[c]	Weight loss[d], %	Volume shrinkage[e], %
8	Hysol 4248	6	302	Unheated control	86 D	31.5	5.18×10^{14}	1.54×10^{15}	620	1.210		
					86 D	30.5	8.94×10^{14}	1.93×10^{15}	475	1.209		
					85 D		(avg.) 7.71×10^{14}	(avg.) 1.74×10^{15}	(avg.) 547	1.209		
					(avg.) 85.7 D					(avg.) 1.209		
				Three cycles of 40 hr at 300°F	86 D	28.5	9.59×10^{14}	7.74×10^{14}	702	1.205	0.593	(avg.) 1.99
					87 D	30.5	5.36×10^{14}	7.74×10^{14}	490	1.206	0.576	
					87 D	31.0	5.27×10^{14}	3.87×10^{14}	610	1.208	0.595	
					(avg.) 86.7 D		(avg.) 6.74×10^{14}	(avg.) 6.45×10^{14}	(avg.) 601	(avg.) 1.206	(avg.) 0.588	
9	Number 5721 (Uralane)	6	180	Unheated control	75 A	—	—	—	—	—		
					84 A							
					74 A							
					(avg.) 77.8 A							
				Three cycles of 40 hr at 300°F	66 A	—	—	—	—	—	1.902	2.28
					64 A						1.808	3.39
					67 A						1.856	4.28
					(avg.) 66.0 A						(avg.) 1.855	(avg.) 3.32 (expansion)
12	PR 1930-2/PR 1902	72	Room temperature	Unheated control	50 A	85.0	5.41×10^{14}	3.09×10^{15}	588	1.441		
					50 A	86.0	6.70×10^{14}	3.09×10^{15}	582	1.451		
					50 A	86.5	5.33×10^{14}	4.64×10^{15}	585	1.444		
					(avg.) 50 A		(avg.) 5.81×10^{14}	(avg.) 3.61×10^{15}	(avg.) 585	(avg.) 1.445		
				Three cycles of 40 hr at 300°F	40 A	85.5	1.07×10^{14}	2.16×10^{15}	585	1.447	1.224	0.75
					39 A	83.0	8.02×10^{13}	1.85×10^{15}	578	1.465	1.136	0.92
					40 A	85.5	8.62×10^{13}	1.85×10^{15}	562	1.441	(avg.) 1.180	(avg.) 0.84
					(avg.) 40 A		(avg.) 9.11×10^{13}	(avg.) 1.95×10^{15}	(avg.) 575	(avg.) 1.451		
13	Proseal 777	3	180	Unheated control	72 A	107.5	1.32×10^{10}	2.32×10^{11}	300	1.298		
					72 A	106.1	1.07×10^{10}	2.94×10^{11}	245	1.317		
		2	180		72 A	107.5	9.06×10^{9}	3.56×10^{11}	240	1.320		
		1	275		(avg.) 72 A		(avg.) 1.10×10^{10}	(avg.) 2.94×10^{11}	(avg.) 262	(avg.) 1.312		
				Three cycles of 40 hr at 300°F	11 A	85.0	4.33×10^{9}	1.05×10^{11}	227	1.333	3.416	7.76
					14 A	84.0	4.37×10^{9}	1.47×10^{11}	170	1.329	3.263	7.14
					13 A	145.0	3.94×10^{9}	4.64×10^{10}	148	1.330	2.688	7.27
					(avg.) 13 A		(avg.) 4.21×10^{9}	(avg.) 9.95×10^{10}	(avg.) 181	(avg.) 1.331	(avg.) 3.122	(avg.) 7.39

Table B-4 (cont'd)

No. (Table 8)	Commercial designation	Cure schedule for unheated controls		Thermal exposure conditions	Shore hardness[a]	Electrical properties				Physical and thermal properties		
		Duration, hr	Temperature, °F			Thickness, mil	Volume resistivity[b], Ω-cm	Surface resistivity[b], Ω	Dielectric strength[b], v/mil	Specific gravity[c]	Weight loss[d], %	Volume shrinkage[e], %
14	RTV G-310	24	Room temperature	Unheated control	29 A	90.5	1.02×10^{13}	3.09×10^{13}	553	1.327		
					29 A	87.0	1.00×10^{13}	3.40×10^{13}	574	1.306		
					28 A	87.0	9.29×10^{12}	3.87×10^{13}	574	1.298		
					(avg.) 29 A		(avg.) 9.83×10^{12}	(avg.) 3.45×10^{13}	(avg.) 562	(avg.) 1.310		
				Three cycles of 40 hr at 300°F	23 A	86.5	7.73×10^{13}	1.47×10^{15}	578	1.316	2.052	7.58
					23 A	86.0	7.24×10^{12}	1.54×10^{15}	582	1.331	2.007	4.62
					24 A	86.5	8.00×10^{13}	1.54×10^{15}	582	1.344	2.109	(avg.) 6.10
					(avg.) 23 A		(avg.) 7.66×10^{13}	(avg.) 1.52×10^{15}	(avg.) 580	(avg.) 1.330	(avg.) 2.056	
15	RTV 11/Thermolite 12	48	Room temperature	Unheated control	50 A	196.0	2.65×10^{13}	8.21×10^{12}	186	1.186		
					51 A	178.0	1.65×10^{13}	9.14×10^{12}	281	1.186		
					51 A	183.0	1.75×10^{13}	1.39×10^{13}	273	1.185		
					(avg.) 51 A		(avg.) 2.02×10^{13}	(avg.) 1.04×10^{13}	(avg.) 247	(avg.) 1.186		
				Three cycles of 40 hr at 300°F	43 A	192.0	6.47×10^{12}	1.23×10^{13}	260	1.189	1.277	6.56
					44 A	195.0	1.34×10^{13}	7.59×10^{12}	180	1.190	1.114	6.70
					42 A	181.0	1.06×10^{13}	1.28×10^{13}	200	1.188	1.214	(avg.) 6.63
					(avg.) 43 A		(avg.) 1.02×10^{13}	(avg.) 1.09×10^{13}	(avg.) 213	(avg.) 1.189	(avg.) 1.201	
16	RTV 60/Thermolite 12	24	Room temperature	Unheated control	58 A	134.0	7.69×10^{12}	4.95×10^{13}	373	1.498		
					56 A	133.0	6.82×10^{12}	3.40×10^{13}	375	1.495		
					56 A	131.0	6.91×10^{12}	5.73×10^{12}	380	1.495		
					(avg.) 56.8 A		(avg.) 7.14×10^{12}	(avg.) 4.69×10^{13}	(avg.) 376	(avg.) 1.496		
				Three cycles of 40 hr at 300°F	55 A	129.0	8.51×10^{13}	2.78×10^{15}	388	1.506	1.881	3.79
					56 A	131.0	8.03×10^{13}	2.16×10^{15}	382	1.508	2.005	3.79
					56 A	129.0	9.08×10^{13}	1.85×10^{15}	387	1.509	1.935	(avg.) 3.79
					(avg.) 55.7 A		(avg.) 8.54×10^{13}	(avg.) 2.26×10^{15}	(avg.) 386	(avg.) 1.507	(avg.) 1.940	
17	RTV 881	>24	Room temperature	Unheated control	38 A	106.0	8.95×10^{13}	2.94×10^{14}	415	1.119		
					38 A	113.0	8.47×10^{13}	3.87×10^{14}	333	1.221		
					39 A	115.0	1.08×10^{14}	7.74×10^{14}	435	1.118		
					(avg.) 38.3 A		(avg.) 9.41×10^{13}	(avg.) 4.85×10^{14}	(avg.) 394	(avg.) 1.120		
				Three cycles of 40 hr at 300°F	30 A	103.0	2.52×10^{13}	2.16×10^{14}	428	1.122	1.223	5.56
					29 A	103.0	2.29×10^{12}	5.42×10^{14}	418	1.123	1.216	2.20
					29 A	91.0	3.31×10^{13}	3.87×10^{14}	452	1.121	1.270	(avg.) 3.88
					(avg.) 29.3 A		(avg.) 2.71×10^{13}	(avg.) 3.82×10^{14}	(avg.) 433	(avg.) 1.122	(avg.) 1.236	

Table B-4 (cont'd)

No. (Table 8)	Commercial designation	Cure schedule for unheated controls		Thermal exposure conditions	Shore hardness[a]	Electrical properties				Physical and thermal properties		
		Duration, hr	Temperature, °F			Thickness, mil	Volume resistivity[b], Ω-cm	Surface resistivity[b], Ω	Dielectric strength[b], v/mil	Specific gravity[c]	Weight loss[d], %	Volume shrinkage[c], %
18	RTV 881+Cab-O-Sil	>24	Room temperature	Unheated control	40 A	97.0	8.21×10^{13}	1.16×10^{14}	387	1.095		
					43 A	135.0	6.91×10^{13}	1.93×10^{14}	356	1.086		
					42 A	128.0	8.57×10^{13}	2.32×10^{14}	328	1.091		
					(avg.) 41.7 A		(avg.) 7.90×10^{13}	(avg.) 1.80×10^{14}	(avg.) 357	(avg.) 1.091		
				Three cycles of 40 hr at 300°F	35 A	96.0	6.58×10^{12}	2.01×10^{14}	438	1.090	1.369	2.08
					33 A	127.0	6.32×10^{12}	1.39×10^{14}	378	1.098	1.380	1.06
					32 A	135.0	6.19×10^{12}	6.19×10^{13}	352	1.104	1.343	1.58
					(avg.) 33.3 A		(avg.) 6.36×10^{12}	(avg.) 1.34×10^{14}	(avg.) 389	(avg.) 1.097	(avg.) 1.364	(avg.) 1.57
19	RTV 881+DC 200	>24	Room temperature	Unheated control	37 A	130.0	3.00×10^{14}	1.54×10^{15}	385	1.128		
					39 A	128.0	2.66×10^{14}	2.01×10^{15}	391	1.127		
					40 A	133.0	3.13×10^{14}	1.54×10^{15}	376	1.132		
					(avg.) 39 A		(avg.) 2.93×10^{14}	(avg.) 1.70×10^{15}	(avg.) 384	(avg.) 1.129		
				Three cycles of 40 hr at 300°F	27 A	133.0	1.29×10^{13}	1.08×10^{14}	376	1.104	1.557	14.76
					28 A	112.0	1.70×10^{13}	1.70×10^{14}	447	1.100	1.541	16.04
					28 A	112.0	1.28×10^{13}	1.85×10^{14}	447	1.098	1.485	(avg.) 15.40
					(avg.) 28.2 A		(avg.) 1.42×10^{13}	(avg.) 1.54×10^{14}	(avg.) 423	(avg.) 1.101	(avg.) 1.528	
20	Scotchcast 260	½	400	Unheated control	84 D	70.0	1.60×10^{15}	5.42×10^{15}	429	1.370		
					84 D	53.0	1.66×10^{15}	5.42×10^{15}	670	1.374		
					85 D		(avg.) 1.63×10^{15}	(avg.) 5.42×10^{15}	(avg.) 549	(avg.) 1.372		
					(avg.) 84.3 D							
				Three cycles of 40 hr at 300°F	83 D	61.0	4.00×10^{15}	3.87×10^{15}	443	1.366	0.934	1.13
					85 D	67.0	2.51×10^{15}	6.19×10^{15}	395	1.371	0.926	1.98
					86 D	57.0	3.10×10^{15}	7.74×10^{15}	474	1.374	(avg.) 0.931	2.00
					(avg.) 84.7 D		(avg.) 3.20×10^{15}	(avg.) 5.93×10^{15}	(avg.) 437	(avg.) 1.372		(avg.) 1.70
21	Scotchcast Resin No. 3	16	170	Unheated control	80 D	32.0	8.85×10^{14}	2.24×10^{15}	970	1.097		
					81 D	32.0	1.36×10^{15}	1.31×10^{14}	1,060	1.099		
					80 D	32.9	6.61×10^{14}	1.85×10^{15}	945	1.091		
					(avg.) 80 D		(avg.) 9.68×10^{14}	(avg.) 5.73×10^{15}	(avg.) 992	(avg.) 1.096		
				Three cycles of 40 hr at 300°F	80 D	31.7	5.15×10^{14}	3.56×10^{15}	945	1.088	10.210	8.82
					82 D	29.0	1.73×10^{14}	3.09×10^{15}	965	1.088	9.460	2.94
					81 D	31.7	4.12×10^{14}	2.78×10^{15}	885	1.088	10.750	(avg.) 5.83
					(avg.) 81 D		(avg.) 3.67×10^{14}	(avg.) 3.14×10^{15}	(avg.) 932	(avg.) 1.088	(avg.) 10.140	

Table B-4 (cont'd)

No. (Table 8)	Commercial designation	Cure schedule for unheated controls		Thermal exposure conditions	Shore hardness[a]	Electrical properties				Physical and thermal properties		
		Duration, hr	Temperature, °F			Thickness, mil	Volume resistivity[b], Ω-cm	Surface resistivity[b] Ω	Dielectric strength[b], v/mil	Specific gravity[c]	Weight loss[d], %	Volume shrinkage[e], %
22	Scotchcast Resin 241 A/B	6	205	Unheated control	41 D	128.0	3.04×10^{14}	2.32×10^{15}	391	1.457		
					41 D	127.0	2.30×10^{14}	1.85×10^{15}	394	1.457		
					41 D	126.0	3.47×10^{14}	2.01×10^{15}	397	1.458		
					(avg.) 41 D		(avg.) 2.94×10^{14}	(avg.) 2.06×10^{15}	(avg.) 394	(avg.) 1.457		
				Three cycles of 40 hr at 300°F	70 D	127.0	9.39×10^{14}	1.85×10^{15}	394	1.469	(avg.) 0.000	1.55
					68 D	128.0	1.46×10^{15}	7.74×10^{15}	367	1.462		0.77
					69 D	130.0	1.12×10^{15}	6.19×10^{15}	385	1.462		(avg.) 1.16
					(avg.) 69 D		(avg.) 1.17×10^{15}	(avg.) 5.26×10^{15}	(avg.) 382	(avg.) 1.464		
23	Solithane 113/300	1	300	Unheated control	60 A	106.0	2.01×10^{14}	7.74×10^{15}	472	1.057		
					60 A	105.0	2.25×10^{14}	1.16×10^{16}	420	1.049		
					61 A	107.0	1.99×10^{14}	7.74×10^{15}	467	1.049		
					(avg.) 60.3 A		(avg.) 2.13×10^{14}	(avg.) 9.02×10^{15}	(avg.) 453	(avg.) 1.051		
				Three cycles of 40 hr at 300°F	52 A	126.0	2.89×10^{14}	3.09×10^{15}	397	1.049	0.396	3.79
					52 A	126.0	3.08×10^{14}	4.64×10^{15}	397	1.047	0.303	4.65
					52 A	126.0	3.08×10^{14}	1.54×10^{15}	397	1.045	0.361	4.65
					(avg.) 52.5 A		(avg.) 3.02×10^{14}	(avg.) 3.09×10^{15}	(avg.) 397	(avg.) 1.047	(avg.) 0.353	(avg.) 4.36
24	Solithane 113/300/328/T-12	1	300	Unheated control	60 A	138.0	2.15×10^{14}	5.40×10^{15}	362	1.065		
					60 A	106.0	1.00×10^{13}	7.00×10^{14}	453	1.065		
					60 A	150.0	5.90×10^{13}	3.00×10^{14}	333	1.068		
					(avg.) 60 A		(avg.) 9.50×10^{13}	(avg.) 2.10×10^{15}	(avg.) 383	(avg.) 1.066		
				Three cycles of 40 hr at 300°F	71 A	103.0	9.00×10^{14}	7.50×10^{15}	485	1.059	2.815	2.31
					72 A	124.0	1.60×10^{15}	3.40×10^{15}	403	1.056	2.245	3.22
					71 A	132.0	1.50×10^{15}	3.90×10^{15}	379	1.058	2.404	3.05
					(avg.) 71.4 A		(avg.) 1.30×10^{15}	(avg.) 4.90×10^{15}	(avg.) 422	(avg.) 1.057	(avg.) 2.488	(avg.) 2.86
25	Solithane 113/300/Calcofluor	1	300	Unheated control	59 A	103.0	1.40×10^{15}	3.10×10^{15}	456	1.053		
					60 A	104.0	1.50×10^{15}	2.30×10^{15}	481	1.050		
					61 A	128.0	1.70×10^{15}	3.90×10^{15}	390	1.049		
					(avg.) 60.2 A		(avg.) 1.50×10^{15}	(avg.) 3.10×10^{15}	(avg.) 442	(avg.) 1.051		
				Three cycles of 40 hr at 300°F	56 A	126.0	6.60×10^{14}	2.60×10^{15}	397	1.051	0.425	4.72
					56 A	128.0	4.60×10^{14}	2.30×10^{15}	390	1.048	0.286	3.01
					58 A	126.0	5.60×10^{14}	3.10×10^{15}	397	1.047	0.328	(avg.) 3.87
					(avg.) 56.8 A		(avg.) 5.60×10^{14}	(avg.) 2.70×10^{15}	(avg.) 395	(avg.) 1.049	(avg.) 0.346	

Table B-4 (cont'd)

No. (Table 8)	Commercial designation	Cure schedule for unheated controls		Thermal exposure conditions	Shore hardness[a]	Electrical properties				Physical and thermal properties			
		Duration, hr	Temperature, °F			Thickness, mil	Volume resistivity[b], Ω-cm	Surface resistivity[b], Ω	Dielectric strength[b], v/mil	Specific gravity[c]	Weight loss[d], %	Volume shrinkage[c], %
26	Stycast 1090/9	24	Room temperature	Unheated control	78 D	36.8	1.00×10^{14}	1.23×10^{14}	334	0.845		
					78 D	31.1	2.31×10^{14}	2.32×10^{14}	323	0.844		
					76 D	36.3	7.18×10^{13}	1.31×10^{14}	344	0.842		
					(avg.) 77.3 D		(avg.) 1.34×10^{14}	(avg.) 1.62×10^{14}	(avg.) 334	(avg.) 0.844		
				Three cycles of 40 hr at 300°F	74 D	36.6	4.93×10^{14}	2.78×10^{14}	390	0.841	(avg.) 0.000	1.95
					75 D	30.8	11.30×10^{14}	2.16×10^{14}	364	0.840		1.70
					73 D	34.7	5.90×10^{14}	2.47×10^{14}	300	0.839		(avg.) 1.82
					(avg.) 74 D		(avg.) 7.39×10^{14}	(avg.) 2.47×10^{14}	(avg.) 352	(avg.) 0.840		
27	Stycast 1090/11	2	212	Unheated control	75 D	33.1	2.36×10^{13}	4.18×10^{14}	185	0.826		
					76 D	32.4	3.15×10^{13}	1.23×10^{14}	207	0.817		
					77 D	31.0	4.71×10^{13}	6.04×10^{14}	139	0.825		
					(avg.) 76 D		(avg.) 3.40×10^{13}	(avg.) 3.82×10^{14}	(avg.) 177	(avg.) 0.823		
				Three cycles of 40 hr at 300°F	69 D	32.2	1.69×10^{14}	6.50×10^{14}	174	0.816	1.045	7.74
					71 D	33.5	6.49×10^{14}	5.42×10^{14}	131	0.826	0.537	8.49
					70 D	33.9	5.77×10^{14}	5.42×10^{14}	183	0.818	0.417	6.56
					(avg.) 70 D		(avg.) 4.65×10^{14}	(avg.) 5.78×10^{14}	(avg.) 163	(avg.) 0.820	(avg.) 0.666	(avg.) 7.60
28	Stycast 1264 A/B	3	150	Unheated control	80 D	127.0	3.83×10^{15}	3.09×10^{15}	362	1.151		
					79 D	126.0	3.28×10^{15}	2.47×10^{15}	397	1.149		
					80 D	126.0	3.86×10^{15}	3.09×10^{15}	397	1.150		
					(avg.) 79.9 D		(avg.) 3.65×10^{15}	(avg.) 2.88×10^{15}	(avg.) 385	(avg.) 1.150		
				Three cycles of 40 hr at 300°F	82 D	127.0	1.91×10^{15}	3.09×10^{13}	394	1.152	3.599	5.43
					81 D	124.0	4.40×10^{15}	1.85×10^{15}	403	1.153	3.684	3.91
					82 D	126.0	4.82×10^{15}	3.87×10^{15}	397	1.152	3.150	(avg.) 4.67
					(avg.) 81.7 D		(avg.) 3.71×10^{15}	(avg.) 2.93×10^{15}	(avg.) 398	(avg.) 1.152	(avg.) 3.553	
29	Stycast 2651/11	2	165	Unheated control	Rockwell: H82	104.0	1.11×10^{15}	7.30×10^{14}	480	1.600		
					H72	95.0	1.35×10^{14}	4.00×10^{14}	525	1.603		
		2	220		H71	103.0	8.48×10^{14}	1.16×10^{15}	485	1.603		
					(avg.) H76.5		(avg.) 6.97×10^{14}	(avg.) 7.73×10^{14}	(avg.) 496	(avg.) 1.602		
				Three cycles of 40 hr at 300°F	Rockwell: H82	85.0	2.57×10^{15}	1.19×10^{14}	590	1.564	0.480	5.45
					H70	89.0	1.06×10^{15}	5.26×10^{14}	560	1.560	1.220	5.54
					H71	100.0	1.05×10^{14}	2.01×10^{14}	450	1.580	1.300	4.55
					(avg.) H76.9		(avg.) 1.24×10^{15}	(avg.) 2.82×10^{14}	(avg.) 533	(avg.) 1.568	0.410	(avg.) 5.18
											(avg.) 0.852	

Table B-4 (cont'd)

No. (Table 8)	Commercial designation	Cure schedule for unheated controls		Thermal exposure conditions	Shore hardness[a]	Electrical properties				Physical and thermal properties		
		Duration, hr	Temperature, °F			Thickness, mil	Volume resistivity[b], Ω-cm	Surface resistivity[b], Ω	Dielectric strength[b], v/mil	Specific gravity[c]	Weight loss[d], %	Volume shrinkage[e], %
30	Stycast 2741/15	½	160	Unheated control	63 D	128.0	(avg.) 8.95×10^{13}	(avg.) 1.11×10^{13}	(avg.) 391	1.278		
					61 D					1.264		
					(avg.) 62 D					1.283		
										(avg.) 1.275		
				Three cycles of 40 hr at 300°F	70 D	125.0	4.66×10^{14}	2.32×10^{15}	400	1.289	4.178	7.52
					73 D	125.0	3.88×10^{14}	2.01×10^{15}	400	1.265	4.402	6.82
					73 D	126.0	6.17×10^{14}	3.87×10^{15}	397	1.285	4.271	(avg.) 7.17
					(avg.) 72 D		(avg.) 4.90×10^{14}	(avg.) 2.73×10^{15}	(avg.) 399	(avg.) 1.280	(avg.) 4.284	
31	Stycast 2850 GT/9	24	Room temperature	Unheated control	92 D	40.9	7.98×10^{14}	3.87×10^{14}	310	2.247		
					89 D	38.5	3.89×10^{15}	7.74×10^{14}	340	2.325		
					91 D	40.3	1.45×10^{15}	2.32×10^{14}	340	2.291		
					(avg.) 91 D		(avg.) 2.38×10^{15}	(avg.) 4.64×10^{14}	(avg.) 330	(avg.) 2.288		
				Three cycles of 40 hr at 300°F	89 D	37.9	4.87×10^{15}	9.29×10^{14}	340	2.273	0.429	7.83
					88 D	38.2	4.83×10^{15}	1.16×10^{15}	325	2.272	0.350	7.62
					92 D	35.5	4.28×10^{15}	1.00×10^{15}	360	2.271	0.424	(avg.) 7.72
					(avg.) 90 D		(avg.) 4.66×10^{15}	(avg.) 1.03×10^{15}	(avg.) 341	(avg.) 2.272	(avg.) 0.401	
32	Stycast 3050/9	1	160	Unheated control	Rockwell:	96.7	4.60×10^{14}	3.71×10^{14}	280	1.590		
					(avg.) H59.7	88.9	6.77×10^{14}	2.94×10^{14}	287	1.581		
						97.9	6.46×10^{14}	3.09×10^{14}	271	1.576		
							(avg.) 5.94×10^{14}	(avg.) 3.25×10^{14}	(avg.) 279	(avg.) 1.583		
				Three cycles of 40 hr at 300°F	Rockwell:	96.4	3.64×10^{14}	3.40×10^{14}	520	1.602	1.180	5.07
					(avg.) H59.2	97.8	8.15×10^{14}	2.63×10^{14}	510	1.584	1.210	6.94
						96.4	7.04×10^{14}	2.16×10^{14}	520	1.579	1.170	4.48
							(avg.) 6.27×10^{14}	(avg.) 2.73×10^{14}	(avg.) 516	(avg.) 1.588	1.190	(avg.) 5.49
											(avg.) 1.187	
33	Sylgard 182	4	300	Unheated control	50 A	96.0	2.92×10^{14}	6.66×10^{14}	328	1.021		
					49 A	96.0	4.14×10^{13}	3.56×10^{14}	334	1.016		
					50 A	96.0	1.34×10^{13}	5.26×10^{14}	328	1.015		
					(avg.) 50.0 A		(avg.) 1.15×10^{14}	(avg.) 5.16×10^{14}	(avg.) 330	(avg.) 1.017		
				Three cycles of 40 hr at 300°F	51 A	96.0	1.19×10^{15}	9.29×10^{14}	318	1.032	0.838	5.21
					51 A	95.0	1.74×10^{15}	1.08×10^{15}	316	1.032	0.871	2.45
					54 A	97.0	2.02×10^{15}	9.29×10^{14}	320	1.032	0.856	1.59
					(avg.) 52.0 A		(avg.) 1.65×10^{15}	(avg.) 9.79×10^{14}	(avg.) 318	(avg.) 1.032	(avg.) 0.855	(avg.) 3.08
34	Sylgard 184	24	77	Unheated control	(avg.) 51 A	119.0	3.24×10^{15}	3.87×10^{15}	336	1.040		
						112.0	3.20×10^{15}	3.48×10^{15}	380	1.041		
		1	150			116.0	3.52×10^{15}	5.42×10^{15}	336	1.040		
							(avg.) 3.32×10^{15}	(avg.) 4.25×10^{15}	(avg.) 360	(avg.) 1.040		
				Three cycles of 40 hr at 300°F	(avg.) 46 A	114.0	2.94×10^{15}	7.74×10^{15}	360	1.042	1.042	(avg.) 1.32
						109.0	2.62×10^{15}	3.87×10^{15}	435	1.042	1.084	
						116.0	2.07×10^{15}	7.74×10^{15}	375	1.042	0.992	
							(avg.) 2.54×10^{15}	(avg.) 6.45×10^{15}	(avg.) 390	(avg.) 1.042	(avg.) 1.039	

Table B-5. Thermal sterilization test data for films

No. (Table 9)	Commercial designation	Thermal exposure conditions	Mechanical properties: Tensile strength and elongation[a] — Stressed dimensions, width/thickness, in.	Tensile strength, psi	Elongation, %	Mechanical properties: Tear strength[b] — Sample thickness, mil	Tear strength, lb/in.	Electrical properties[c] — Sample thickness, mil	Volume resistivity, Ω-cm	Surface resistivity, Ω	Dielectric strength, v/mil	Weight loss[d], %
1	H-Film (Kapton)	Unheated control	1.007/0.0030	26,666	75.0	3.00	2,916	3.5	1.76×10^{17}	1.23×10^{15}	3,800	
			1.058/0.0031	22,064	70.5	2.80	2,714	3.1	8.03×10^{15}	1.23×10^{15}	3,970	
			1.012/0.0032	26,343	89.5	2.80	3,142	3.3	1.04×10^{17}	1.39×10^{15}	3,880	
			1.007/0.0034	21,823	51.5	2.70	2,814		(avg.) 1.20×10^{16}	(avg.) 1.28×10^{15}	(avg.) 3,884	
			1.014/0.0031	23,870	62.1	3.20	4,437					
				(avg.) 24,153	(avg.) 70	3.20	3,531					
							(avg.) 3,259					
		Three cycles of 40 hr at 300°F	0.997/0.0030	16,666	24.8	2.90	3,275	3.2	6.89×10^{16}	3.87×10^{14}	3,750	0.595
			1.000/0.0029	19,556	30.8	3.10	3,267	3.3	8.59×10^{16}	4.18×10^{14}	3,990	0.654
			0.998/0.0029	19,932	27.2	3.00	3,173	3.2	1.03×10^{17}	5.42×10^{14}	3,950	(avg.) 0.624
			1.000/0.0029	20,945	41.3	2.90	2,758		(avg.) 8.59×10^{16}	(avg.) 4.49×10^{14}	(avg.) 3,896	
			0.995/0.0030	19,900	(avg.) 31		(avg.) 3,118					
			0.998/0.0030	21,866								
				(avg.) 19,811								
2	Mylar Type A (10 mils)	Unheated control	0.970/0.0099	20,202	95.0	9.90	3,232	9.8	2.86×10^{16}	8.05×10^{14}	2,140	
			1.008/0.0098	20,408	101.0	10.10	3,069	10.1	1.80×10^{16}	1.08×10^{15}	2,480	
			1.002/0.0099	21,414	116.0	10.00	3,380	9.9	3.69×10^{16}	1.00×10^{15}	2,420	
			1.003/0.0098	19,081	82.0	10.00	3,880		(avg.) 2.78×10^{16}	(avg.) 9.62×10^{14}	(avg.) 2,333	
			1.004/0.0098	22,448	124.0	10.00	3,420					
			0.986/0.0099	20,404	94.0	10.00	3,400					
				(avg.) 20,659	(avg.) 102		(avg.) 3,396					
		Three cycles of 40 hr at 300°F	0.980/0.0100	14,855	236.4	10.00	3,180	10.1	3.61×10^{16}	5.88×10^{14}	2,620	0.141
			0.996/0.0099	14,909	142.4	10.10	3,158	10.0	2.43×10^{16}	4.95×10^{14}	2,700	0.157
			0.984/0.0100	14,580	283.2	10.00	2,960	10.3	3.53×10^{16}	4.49×10^{14}	2,330	0.176
			0.984/0.0100	14,736	148.0	10.00	2,930		(avg.) 3.19×10^{16}	(avg.) 5.10×10^{14}	(avg.) 2,550	(avg.) 0.158
			0.987/0.0100	14,518	239.2		(avg.) 3,057					
			0.994/0.0100	14,900	172.0							
				(avg.) 14,749	(avg.) 204							
3	Mylar Type C (1 mil)	Unheated control	1.008/0.0010	22,600	30.0	1.00	4,170	1.2	2.69×10^{16}	1.54×10^{15}	5,000	
			1.004/0.0010	23,600	35.8	1.00	3,650	1.2	7.83×10^{16}	1.23×10^{15}	5,000	
			1.005/0.0010	15,400	5.7	1.00	4,150	1.2	3.91×10^{16}	1.39×10^{15}	5,100	
			1.002/0.0010	27,600	37.6	1.00	3,700		(avg.) 4.81×10^{16}	(avg.) 1.39×10^{15}	(avg.) 5,033	
			1.003/0.0010	21,500	20.0	1.00	4,400					
			1.005/0.0010	16,300	7.8	1.00	3,800					
				(avg.) 21,166	(avg.) 23		(avg.) 3,978					
		Three cycles of 40 hr at 300°F	0.977/0.0012	10,683	3.0	1.00	3,920	1.2	5.13×10^{16}	5.73×10^{14}	4,720	0.183
			0.985/0.0012	7,541	1.7	1.00	4,060	1.2	6.85×10^{16}	4.95×10^{14}	4,900	0.139
			0.971/0.0012	8,290	1.8	1.00	3,490	1.2	4.89×10^{16}	6.04×10^{14}	4,820	0.228
			0.974/0.0011	13,745	5.1	1.00	3,530		(avg.) 5.63×10^{16}	(avg.) 5.57×10^{14}	(avg.) 4,813	(avg.) 0.183
			0.988/0.0011	13,628	5.1		(avg.) 3,750					
			0.969/0.0010	6,750	1.5							
				(avg.) 10,106	(avg.) 3							

[a]ASTM D882—61T. [b]ASTM D624—54. [c]ASTM D257 [d]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

Table B-5 (cont'd)

No. (Table 9)	Commercial designation	Thermal exposure conditions	Mechanical properties: Tensile strength and elongation[a] — Stressed dimensions, width/thickness, in.	Tensile strength, psi	Elongation, %	Mechanical properties: Tear strength[b] — Sample thickness, mil	Tear strength, lb/in.	Electrical properties[c] — Sample thickness, mil	Volume resistivity, Ω-cm	Surface resistivity, Ω	Dielectric strength, v/mil	Weight loss[d], %
4	Mylar Type D (3 mils)	Unheated control	1.004/0.0030	18,000	58.1	2.90	4,017	2.9	2.86×10^{16}	1.54×10^{15}	3,830	
			— /0.0030	18,600	49.3	2.90	3,948	2.9	2.77×10^{16}	2.32×10^{15}	3,830	
			0.992/0.0030	17,366	48.2	2.90	3,948	2.9	8.32×10^{16}	1.54×10^{15}	3,730	
			0.994/0.0030	22,866	94.3	2.90	4,075		(avg.) 4.65×10^{16}	(avg.) 1.80×10^{15}	(avg.) 3,800	
			0.994/0.0030	22,266	91.5	2.90	4,051					
			— /0.0030	22,433	93.2	2.90	4,189					
				(avg.) 20,255	(avg.) 72		(avg.) 4,038					
		Three cycles of 40 hr at 300°F	0.967/0.0031	17,516	75.2	3.10	3,090	3.3	4.17×10^{16}	5.57×10^{14}	3,180	0.077
			0.992/0.0030	18,666	59.1	2.90	3,241	3.3	4.67×10^{16}	5.88×10^{14}	3,200	0.077
			0.988/0.0031	18,660	73.0	3.10	2,983	3.3	4.08×10^{16}	7.43×10^{14}	2,980	0.076
			0.991/0.0030	18,066	56.1	3.00	3,350		(avg.) 4.31×10^{16}	(avg.) 6.29×10^{14}	(avg.) 3,120	(avg.) 0.077
			0.955/0.0031	17,387	62.7		(avg.) 3,166					
			0.993/0.0030	18,366	65.2							
				(avg.) 18,110	(avg.) 65							
5	Mylar Type D (5 mils)	Unheated control	1.008/0.0050	17,920	52.6	5.00	3,520	5.2	5.57×10^{16}	1.16×10^{15}	3,140	
			1.004/0.0050	21,900	112.0	5.10	3,470	5.3	1.28×10^{17}	1.00×10^{15}	3,080	
			1.004/0.0050	21,320	104.0	5.00	3,520	5.3	9.42×10^{16}	9.29×10^{14}	3,080	
			1.0035/0.0050	22,080	112.2	5.10	3,392		(avg.) 9.26×10^{16}	(avg.) 1.04×10^{15}	(avg.) 3,100	
			1.007/0.0050	22,860	120.4	5.00	3,560					
			0.986/0.0050	19,800	89.4	5.00	3,820					
				(avg.) 20,980	(avg.) 98		(avg.) 3,547					
		Three cycles of 40 hr at 300°F	0.910/0.0053	15,018	20.0	5.00	3,320	5.6	3.03×10^{16}	3.56×10^{14}	2,610	0.191
			0.991/0.0053	15,547	62.5	5.10	3,313	5.6	3.45×10^{16}	3.56×10^{14}	2,600	0.140
			0.979/0.0052	15,423	51.0	5.10	2,862	5.6	3.54×10^{16}	4.33×10^{14}	2,530	0.167
			0.975/0.0053	15,056	48.0	5.10	3,480		(avg.) 3.34×10^{16}	(avg.) 3.82×10^{14}	(avg.) 2,580	(avg.) 0.166
			0.979/0.0053	15,428	51.2		(avg.) 3,219					
			0.976/0.0052	15,384	27.0							
				(avg.) 15,309	(avg.) 43							
6	Mylar Type HS	Unheated control	0.498/0.0016	9,790	12.5	1.30	2,080	1.7	1.18×10^{16}	4.70×10^{15}	4,120	
			0.497/0.0015	10,500	10.0	1.40	1,860	1.6	6.30×10^{15}	4.20×10^{15}	4,180	
			0.504/0.0016	10,200	12.5	2.00	1,650	1.8	8.70×10^{15}	3.90×10^{15}	3,720	
			0.503/0.0015	10,900	(avg.) 12	1.70	2,060		(avg.) 8.90×10^{15}	(avg.) 4.30×10^{15}	(avg.) 4,007	
				(avg.) 10,300			(avg.) 1,910					
		Three cycles of 40 hr at 300°F	0.502/0.0015	15,000	12.5	3.30	1,830	1.7	5.90×10^{15}	3.90×10^{15}	4,000	(avg.) 0.000
			0.503/0.0015	14,200	12.5	4.10	2,160	1.7	1.06×10^{16}	3.50×10^{15}	4,350	
			0.504/0.0015	13,400	7.5	5.30	3,530	1.7	8.20×10^{15}	3.60×10^{15}	4,230	
			0.502/0.0015	14,200	(avg.) 11	3.60	2,120		(avg.) 8.20×10^{15}	(avg.) 3.70×10^{15}	(avg.) 4,193	
				(avg.) 14,200			(avg.) 2,410					

Table B-5 (cont'd)

No. (Table 9)	Commercial designation	Thermal exposure conditions	Mechanical properties					Electrical properties[c]				Weight loss[d], %
			Tensile strength and elongation[a]			Tear strength[b]						
			Stressed dimensions, width/thickness, in.	Tensile strength, psi	Elongation, %	Sample thickness, mil	Tear strength, lb/in.	Sample thickness, mil	Volume resistivity, Ω-cm	Surface resistivity, Ω	Dielectric strength, v/mil	
7	Mylar M22 (1 mil)	Unheated control	1.007/0.0009	13,066	20.2	0.90	2,844	1.0	1.39×10^{16}	1.13×10^{15}	4,050	
			1.000/0.0009	16,888	84.9	0.90	2,883	1.0	1.30×10^{16}	1.00×10^{15}	4,600	
			1.005/0.0009	14,422	40.1	0.90	2,327	1.0	1.36×10^{16}	1.00×10^{15}	4,600	
			1.005/0.0009	13,844	37.4	0.90	3,438		(avg.) 1.35×10^{16}	(avg.) 1.04×10^{15}	(avg.) 4,410	
			1.004/0.0009	15,000	60.2	0.90	2,955					
			1.006/0.0009	12,888	12.4	0.90	3,383					
				(avg.) 14,351	(avg.) 43		(avg.) 2,972					
		Three cycles of 40 hr at 300°F	0.993/0.0010	11,800	12.5	1.00	2,180	1.2	2.08×10^{16}	3.87×10^{14}	4,120	6.140
			0.964/0.0009	11,591	3.5	1.00	2,940	1.2	1.39×10^{16}	4.64×10^{14}	3,920	5.970
			0.995/0.0010	11,907	10.5	0.90	3,144	1.2	1.49×10^{16}	4.64×10^{14}	4,240	6.070
			0.988/0.0010	11,700	9.9	0.90	2,588		(avg.) 1.65×10^{16}	(avg.) 4.39×10^{14}	(avg.) 4,110	(avg.) 6.058
			0.995/0.0009	13,222	6.4		(avg.) 2,713					
			0.996/0.0010	11,649	15.6							
				(avg.) 11,978	(avg.) 10							
8	Tedlar 200 AM 30 WH	Unheated control	1.002/0.0022	8,250	89.6	2.20	2,068	2.3	7.50×10^{14}	9.29×10^{14}	2,180	
			1.000/0.0022	7,931	75.2	2.20	1,831	2.4	1.46×10^{15}	1.31×10^{15}	2,160	
			1.004/0.0022	7,954	78.6	2.20	1,950	2.3	8.12×10^{14}	1.16×10^{15}	2,220	
			1.003/0.0022	8,181	89.2	2.20	1,822		(avg.) 1.01×10^{15}	(avg.) 1.13×10^{15}	(avg.) 2,186	
			1.005/0.0022	7,818	81.6	2.10	1,995					
			1.002/0.0022	8,000	79.7	2.10	1,776					
				(avg.) 8,022	(avg.) 82		(avg.) 1,907					
		Three cycles of 40 hr at 300°F	0.965/0.0021	10,714	104.1	2.20	1,954	2.5	1.68×10^{15}	1.93×10^{14}	2,140	0.092
			0.960/0.0021	10,619	104.0	2.20	2,027	2.5	1.57×10^{15}	5.43×10^{14}	2,150	0.112
			0.933/0.0020	11,075	104.0	2.20	1,700	2.5	1.68×10^{15}	1.93×10^{14}	2,120	0.114
			0.960/0.0022	10,568	104.0	2.20	2,031		(avg.) 1.64×10^{15}	(avg.) 3.09×10^{14}	(avg.) 2,137	(avg.) 0.106
				(avg.) 10,744	(avg.) 104		(avg.) 1,928					
9	SRD 5905	Unheated control	1.000/0.0052	4,420	28.0	5.50	764	5.4	5.60×10^{14}	1.90×10^{15}	435	
			1.000/0.0053	4,910	28.0	5.40	741	5.2	6.90×10^{14}	2.60×10^{15}	434	
			1.000/0.0053	5,750	28.0	5.20	731	5.3	5.30×10^{14}	3.10×10^{15}	386	
			1.000/0.0051	5,390	30.0	5.20	712		(avg.) 5.90×10^{14}	(avg.) 2.50×10^{15}	(avg.) 418	
				(avg.) 5,118	(avg.) 29		(avg.) 737					
		Three cycles of 40 hr at 300°F	1.000/0.0052	6,150	20.0	5.20	558	5.4	9.20×10^{13}	1.90×10^{15}	463	0.219
			1.000/0.0053	4,870	20.0	5.10	529	5.3	7.60×10^{13}	2.00×10^{15}	443	0.281
			1.000/0.0053	3,870	18.0	5.30	604	5.3	5.70×10^{13}	1.60×10^{15}	443	0.191
			1.000/0.0052	3,810	18.0	5.10	628		(avg.) 7.30×10^{13}	(avg.) 1.80×10^{15}	(avg.) 450	(avg.) 0.230
			1.000/0.0051	5,200	(avg.) 19		(avg.) 580					
			1.000/0.0051	5,390								
				(avg.) 4,882								

Table B-6. Thermal sterilization test data for lubricants (oils and greases)

No. (Table 11)	Commercial designation	Thermal exposure conditions	Viscosity brookfield[a], cp	Cone penetration[b], worked	Weight loss[c], %
1	Aeroshell Grease 7A	Unheated control	—	(avg.) 275	
		Three cycles of 40 hr at 300°F	—	(avg.) 295	19.900 21.000 (avg.) 20.500
3	DC-5 Grease	Unheated control	—	(avg.) 232	
		Three cycles of 40 hr at 300°F	—	(avg.) 232	0.290 0.210 0.140 (avg.) 0.210
4	DC-11 Grease	Unheated control	—	(avg.) 227	
		Three cycles of 40 hr at 300°F	—	(avg.) 227	0.863 1.050 0.896 (avg.) 0.936
5	DC-200, 350cs	Unheated control	414 414 (avg.) 414	—	
		Three cycles of 40 hr at 300°F	410 410 (avg.) 410	—	0.195 0.184 0.170 (avg.) 0.183
7	Versilube F-50	Unheated control	92 92 (avg.) 92	—	
		Three cycles of 40 hr at 300°F	90 90 (avg.) 90	—	0.020 0.016 0.015 (avg.) 0.017

[a]ASTM D2196–63T.

[b]ASTM D217–60T.

[c]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

Table B-7. Thermal sterilization test data for reinforced plastics

No. (Table 12)	Commercial designation	Thermal exposure conditions	Mechanical properties				Electrical properties				Physical and thermal properties
			Hardness rockwell[a]	Stressed dimensions, in.	Tensile strength[b], psi	Elongation[b], %	Thickness, mil	Volume resistivity[c], Ω-cm	Surface resistivity[c], Ω	Dielectric strength[c], v/mil	Weight loss[d], %
1	Diall FS-4	Unheated control	E 88	0.130/0.495	3,420	0.52	133.0	1.29×10^{15}	1.70×10^{14}	376	
			E 89	0.125/0.500	2,800	0.52	130.0	1.41×10^{15}	1.54×10^{14}	385	
			E 91	0.130/0.490	4,130	0.84	130.0	1.78×10^{15}	1.70×10^{14}	385	
			(avg.) E 89.3		(avg.) 3,450	(avg.) 0.63		(avg.) 1.49×10^{15}	(avg.) 1.65×10^{14}	(avg.) 382	
		Three cycles of 40 hr at 300°F	E 94	0.125/0.498	3,180	1.30	129.0	1.89×10^{15}	2.94×10^{15}	388	0.582
			E 95	0.130/0.497	4,180	0.80	126.0	2.70×10^{15}	1.70×10^{15}	397	0.576
			E 95	0.127/0.490	3,780	0.70	130.0	3.38×10^{15}	2.78×10^{15}	385	0.589
			(avg.) E 94.8	0.130/0.499	3,280	0.56		(avg.) 2.66×10^{15}	(avg.) 2.47×10^{15}	(avg.) 390	(avg.) 0.582
					(avg.) 3,610	(avg.) 0.84					
2	Diall FS-10	Unheated control	H 92	0.129/0.494	5,730	1.40	132.0	1.20×10^{15}	1.39×10^{15}	379	
			H 91	0.128/0.493	5,000	0.70	130.0	8.40×10^{14}	1.08×10^{15}	385	
			H 93	0.125/0.500	6,160	0.96	132.0	1.39×10^{15}	7.70×10^{14}	379	
			(avg.) H 92.3	0.128/0.507	5,900	1.00		(avg.) 1.15×10^{15}	(avg.) 1.08×10^{15}	(avg.) 381	
					(avg.) 5,698	(avg.) 1.00					
		Three cycles of 40 hr at 300°F	H 99	0.124/0.502	6,320	0.92	129.0	3.78×10^{15}	5.42×10^{15}	388	0.839
			H 98	0.128/0.501	6,320	0.86	131.0	4.66×10^{15}	3.09×10^{15}	382	0.790
			H 99	0.123/0.500	6,150	1.00	130.0	4.70×10^{15}	3.87×10^{15}	385	0.832
			(avg.) H 99.2		(avg.) 6,260	(avg.) 0.93		(avg.) 4.38×10^{15}	(avg.) 4.13×10^{15}	(avg.) 385	(avg.) 0.820
3	Diall 52-20-30	Unheated control	E 81	0.140/0.492	5,400	0.80	142.0	8.19×10^{14}	8.05×10^{14}	331	
			E 79	0.140/0.496	5,470	0.82	143.0	1.04×10^{15}	1.85×10^{15}	350	
			E 78	0.140/0.496	4,540	0.74	143.0	8.67×10^{14}	2.78×10^{14}	350	
			(avg.) E 79.5	0.140/0.491	4,150	0.68		(avg.) 9.09×10^{14}	(avg.) 9.78×10^{14}	(avg.) 343	
					(avg.) 4,890	(avg.) 0.76					
		Three cycles of 40 hr at 300°F	E 82	0.140/0.500	5,360	0.92	141.0	4.38×10^{15}	4.64×10^{15}	355	0.756
			E 82	0.143/0.498	5,200	0.80	143.0	3.12×10^{15}	3.87×10^{15}	350	0.777
			E 84	0.143/0.501	5,070	0.84	142.0	4.36×10^{15}	4.64×10^{15}	352	0.661
			(avg.) E 83		(avg.) 5,210	(avg.) 0.85		(avg.) 3.95×10^{15}	(avg.) 4.38×10^{15}	(avg.) 353	(avg.) 0.731
4	EG-758-T	Unheated control	E 93	0.118/0.498	65,500	4.2	120.0	2.70×10^{14}	Surface conductive		
			E 93	0.118/0.500	59,300	3.8	116.0	1.30×10^{14}			
			E 92	0.117/0.497	66,200	4.5	115.0	2.60×10^{14}			
			(avg.) E 93	0.118/0.498	59,600	4.0		(avg.) 2.20×10^{14}			
					(avg.) 62,650	(avg.) 4.1					
		Three cycles of 40 hr at 300°F	E 91	0.118/0.498	56,200	3.3	117.0	3.00×10^{15}	Surface conductive		0.0162
			E 96	0.117/0.498	57,900	3.4	117.0	2.00×10^{15}			0.0048
			E 95	0.117/0.499	56,100	3.4	117.0	6.20×10^{15}			0.0059
			(avg.) E 94.2	0.117/0.495	59,130	3.5		(avg.) 3.70×10^{15}			(avg.) 0.010
					(avg.) 57,332	(avg.) 3.4					

[a]ASTM D785. [b]ASTM D638–61T. [c]ASTM D257. [d]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

Table B-7 (cont'd)

No. (Table 12)	Commercial designation	Thermal exposure conditions	Mechanical properties				Electrical properties				Physical and thermal properties
			Hardness rockwell[a]	Stressed dimensions, in.	Tensile strength[b], psi	Elongation[b], %	Thickness, mil	Volume resistivity[c], Ω-cm	Surface resistivity[c], Ω	Dielectric strength[c], v/mil	Weight loss[d], %
5	Fiberglass 91 LD	Unheated control	B 78	0.040/0.498	40,300	2.4	41.0	1.59×10^{13}	1.00×10^{13}	585	
			B 77	0.041/0.499	41,000	3.4	42.5	7.60×10^{12}	6.90×10^{12}	542	
			B 78	0.040/0.500	43,300	3.4	41.5	2.09×10^{13}	6.10×10^{12}	578	
			(avg.) B 77.7	0.040/0.500	37,500	2.8		(avg.) 1.48×10^{13}	(avg.) 7.72×10^{12}	(avg.) 568	
					(avg.) 40,525	(avg.) 3.0					
		Three cycles of 40 hr at 300°F	B 84	0.040/0.498	37,000	2.1	42.0	7.70×10^{13}	7.74×10^{13}	725	1.177
			B 84	0.040/0.499	41,200	2.3	42.0	1.81×10^{14}	3.09×10^{13}	797	1.176
			B 79	0.040/0.498	37,700	2.7	42.0	7.70×10^{13}	3.09×10^{13}	725	1.092
			(avg.) B 82.5	0.040/0.500	39,300	2.2		(avg.) 1.12×10^{14}	(avg.) 4.64×10^{13}	(avg.) 748	(avg.) 1.148
					(avg.) 38,800	(avg.) 2.3					
6	Laminate Type EG 752	Unheated control	H 96	0.016/0.496	34,400	2.0	12.2	5.84×10^{14}	1.39×10^{14}	623	
			H 95	0.018/0.496	30,800	2.1	12.6	3.75×10^{14}	2.01×10^{14}	603	
			H 95	0.019/0.501	27,800	2.0	13.6	1.03×10^{15}	2.32×10^{14}	617	
			(avg.) H 95.5	0.016/0.495	34,700	2.0		(avg.) 6.63×10^{14}	(avg.) 1.91×10^{14}	(avg.) 615	
					(avg.) 31,925	(avg.) 2.0					
		Three cycles of 40 hr at 300°F	H 97	0.017/0.498	32,500	1.8	13.2	1.60×10^{15}	1.08×10^{15}	606	0.271
			H 99	0.016/0.495	36,600	2.2	12.5	2.27×10^{15}	1.00×10^{15}	624	0.242
			H 97	0.016/0.497	35,600	2.1	13.0	1.45×10^{15}	1.23×10^{15}	608	0.251
			(avg.) H 98.5	0.016/0.505	36,300	2.2		(avg.) 1.77×10^{15}	(avg.) 1.10×10^{15}	(avg.) 612	(avg.) 0.255
					(avg.) 35,250	(avg.) 2.1					
7	Laminate Grade H 5834	Unheated control	B 72	0.155/0.498	34,300	3.5	156.0	5.79×10^{13}	1.85×10^{14}	301	
			B 73	0.156/0.499	31,500	3.4	156.0	4.50×10^{13}	1.70×10^{14}	269	
			B 72	0.156/0.498	32,500	3.2	156.0	4.34×10^{13}	1.70×10^{14}	244	
			(avg.) B 72.3	0.156/0.500	29,800	3.4		(avg.) 4.88×10^{13}	(avg.) 1.75×10^{14}	(avg.) 271	
					(avg.) 32,025	(avg.) 3.4					
		Three cycles of 40 hr at 300°F	B 75	0.156/0.512	32,600	3.5	156.0	1.09×10^{15}	0.69×10^{15}	269	1.184
			B 81	0.157/0.499	33,200	3.8	156.0	1.28×10^{15}	1.70×10^{13}	250	1.305
			B 79	0.154/0.497	36,900	4.0	156.0	1.20×10^{15}	1.23×10^{15}	295	1.281
			(avg.) B 78.6	0.156/0.497	33,500	3.3		(avg.) 1.19×10^{15}	(avg.) 1.21×10^{15}	(avg.) 271	(avg.) 1.257
					(avg.) 34,050	(avg.) 3.6					

Table B-7 (cont'd)

No. (Table 12)	Commercial designation	Thermal exposure conditions	Mechanical properties				Electrical properties				Physical and thermal properties
			Hardness rockwell[a]	Stressed dimensions, in.	Tensile strength[b], psi	Elongation[b], %	Thickness, mil	Volume resistivity[c], Ω-cm	Surface resistivity[c], Ω	Dielectric strength[c], v/mil	Weight loss[d], %
8	Laminate NS	Unheated control	H 74	0.127/0.496	6,750	9.6	131.0	3.40×10^{13}	7.00×10^{13}	>382	
			H 81	0.129/0.497	7,180	11.0	131.0	3.70×10^{13}	2.70×10^{14}	>382	
			H 78	0.129/0.497	7,250	11.6	131.0	3.20×10^{13}	1.90×10^{14}	>382	
			H 84	0.128/0.496	7,010	11.0		(avg.) 3.40×10^{13}	(avg.) 1.80×10^{14}	(avg.) >382	
			(avg.) H 79.3		(avg.) 7,048	(avg.) 10.8					
		Three cycles of 40 hr at 300°F	H 87	0.128/0.493	7,050	9.5	131.0	1.20×10^{15}	2.30×10^{15}	>382	2.874
			H 92	0.130/0.495	6,990	8.6	131.0	1.50×10^{15}	3.10×10^{15}	>382	2.806
			H 88	0.129/0.493	7,160	9.4	131.0	2.40×10^{15}	2.60×10^{15}	>385	2.800
			H 94	0.130/0.497	7,200	9.4		(avg.) 1.70×10^{15}	(avg.) 2.70×10^{15}	(avg.) >393	(avg.) 2.827
			(avg.) H 90.3		(avg.) 7,100	(avg.) 9.2					
9	Laminate 500J	Unheated control	E 88	0.066/0.496	44,600	3.4	66.0	9.00×10^{13}	Surface conductive		
			E 88	0.068/0.498	44,000	3.2	66.0	2.20×10^{14}			
			E 90	0.066/0.495	44,400	3.1	65.0	1.80×10^{14}			
			E 87		(avg.) 44,330	(avg.) 3.3		(avg.) 1.63×10^{14}			
			(avg.) E 88.3								
		Three cycles of 40 hr at 300°F	E 90	0.065/0.496	45,000	3.0	63.0	1.70×10^{14}	Surface conductive		0.0031
			E 88	0.065/0.497	48,300	3.1	63.0	3.10×10^{14}			0.0168
			E 90	0.065/0.493	44,300	2.7		(avg.) 2.40×10^{14}			0.0016
			E 88	0.065/0.503	45,600	3.0					(avg.) 0.007
			(avg.) E 89		(avg.) 45,800	(avg.) 2.9					(Weight gain)
10	Micarta Grade 238	Unheated control	E 77	0.126/0.498	8,760	2.2	136.0	7.78×10^{12}	1.70×10^{13}	258	
			E 77	0.126/0.504	8,660	1.7	136.0	7.23×10^{12}	1.85×10^{13}	238	
			E 77	0.126/0.498	8,690	1.7	136.0	1.08×10^{13}	1.39×10^{13}	250	
			(avg.) E 77	0.126/0.502	8,700	1.9		(avg.) 8.60×10^{12}	(avg.) 1.65×10^{13}	(avg.) 248	
					(avg.) 8,703	(avg.) 1.9					
		Three cycles of 40 hr at 300°F	E 82	0.127/0.497	8,480	1.6	135.0	2.73×10^{14}	4.33×10^{14}	371	4.043
			E 81	0.125/0.502	8,450	1.7	135.0	2.73×10^{14}	4.64×10^{14}	371	4.066
			E 82	0.126/0.500	8,490	—	135.0	2.73×10^{14}	1.54×10^{14}	371	4.050
			(avg.) E 82	0.126/0.497	8,700	1.8		(avg.) 2.73×10^{14}	(avg.) 3.50×10^{14}	(avg.) 371	(avg.) 4.053
					(avg.) 8,530	(avg.) 1.7					

Table B-7 (cont'd)

No. (Table 12)	Commercial designation	Thermal exposure conditions	Mechanical properties				Electrical properties				Physical and thermal properties
			Hardness rockwell[a]	Stressed dimensions, in.	Tensile strength[b], psi	Elongation[b], %	Thickness, mil	Volume resistivity[c], Ω-cm	Surface resistivity[c], Ω	Dielectric strength[c], v/mil	Weight loss[d], %
11	Micarta GX (H 17480)	Unheated control	E 92	0.155/0.497	62,100	6.0	156.5	1.60×10^{14}	1.23×10^{14}	320	
			E 91	0.155/0.491	65,500	6.4	156.5	1.28×10^{14}	1.54×10^{14}	291	
			E 92	0.152/0.497	63,700	5.8	156.0	1.61×10^{14}	1.39×10^{14}	321	
			(avg.) E 91.8		(avg.) 63,760	(avg.) 6.1		(avg.) 1.50×10^{14}	(avg.) 1.39×10^{14}	(avg.) >311	
		Three cycles of 40 hr at 300°F	E 92	0.151/0.498	62,500	6.4	154.0	2.44×10^{14}	2.78×10^{14}	318	0.366
			E 91	0.152/0.493	66,600	5.8	154.0	1.95×10^{14}	2.32×10^{14}	305	0.361
			E 93	0.156/0.499	70,000	5.8	151.0	2.98×10^{14}	2.47×10^{14}	325	0.395
			(avg.) E 92.3	0.154/0.496	63,500	6.4		(avg.) 2.46×10^{14}	(avg.) 2.52×10^{14}	(avg.) >316	(avg.) 0.374
					(avg.) 65,650	(avg.) 6.1					
12	Micarta H-2497 (G-11)	Unheated control	F 92	0.122/0.495	48,400	4.2	126.0	1.64×10^{15}	1.08×10^{15}	374	
			F 90	0.123/0.497	45,800	3.8	126.0	2.50×10^{15}	7.28×10^{14}	397	
			F 89	0.120/0.497	41,100	4.4	127.0	1.63×10^{15}	7.74×10^{14}	393	
			(avg.) F 90.3	0.120/0.499	46,400	(avg.) 4.1		(avg.) 1.92×10^{15}	(avg.) 8.61×10^{14}	(avg.) 388	
					(avg.) 45,425						
		Three cycles of 40 hr at 300°F	F 93	0.121/0.498	46,100	3.9	125.0	2.72×10^{15}	2.01×10^{15}	376	0.145
			F 92	0.122/0.498	48,100	3.8	126.0	3.28×10^{15}	2.32×10^{15}	357	0.147
			F 93	0.121/0.495	41,800	3.5	126.0	2.89×10^{15}	2.78×10^{15}	369	0.148
			(avg.) F 93.2	0.124/0.499	46,800	3.5		(avg.) 2.96×10^{15}	(avg.) 2.37×10^{15}	(avg.) 367	(avg.) 0.147
					(avg.) 45,700	(avg.) 3.7					
13	Micarta HY-180 (G-10)	Unheated control	F 72	O.D. I.D.	62,000	Not recorded	168.5	7.88×10^{15}	2.38×10^{15}	>298	
			F 74	0.749/0.560	65,400		170.1	8.95×10^{15}	2.03×10^{15}	>294	
			F 64	0.749/0.560	68,100		170.1	8.20×10^{15}	1.93×10^{15}	>294	
			F 84	0.750/0.562	61,700			(avg.) 8.34×10^{15}	(avg.) 2.11×10^{15}	(avg.) >295	
			(avg.) F 73.5	0.751/0.555	(avg.) 64,300						
		Three cycles of 40 hr at 300°F	F 80	0.751/0.557	62,700	Not recorded	170.9	1.11×10^{16}	2.65×10^{15}	>292	0.143
			F 76	0.750/0.555	60,000		170.9	8.90×10^{15}	2.80×10^{15}	>292	0.139
			F 82	0.751/0.560	60,000		170.9	9.60×10^{15}	2.25×10^{15}	>292	0.166
			F 70	0.751/0.558	59,500			(avg.) 9.90×10^{15}	(avg.) 2.57×10^{15}	(avg.) >292	(avg.) 0.149
			(avg.) F 77		(avg.) 60,550						

Table B-7 (cont'd)

No. (Table 12)	Commercial designation	Thermal exposure conditions	Mechanical properties				Electrical properties				Physical and thermal properties
			Hardness rockwell[a]	Stressed dimensions, in.	Tensile strength[b], psi	Elongation[b], %	Thickness, mil	Volume resistivity[c], Ω-cm	Surface resistivity[c], Ω	Dielectric strength[c], v/mil	Weight loss[d], %
14	Micarta LE-221	Unheated control	F 55	0.129/0.497	6,390	1.6	132.0	9.27×10^{12}	1.08×10^{13}	371	
			F 56	0.130/0.498	8,570	1.2	134.0	9.16×10^{12}	1.23×10^{13}	355	
			F 58	0.130/0.498	8,730	2.0	133.0	1.10×10^{13}	1.08×10^{13}	354	
			(avg.) F 56.5	0.131/0.498	8,200	2.0		(avg.) 9.81×10^{12}	(avg.) 1.13×10^{13}	(avg.) 360	
					(avg.) 7,972	(avg.) 1.7					
		Three cycles of 40 hr at 300°F	F 65	0.130/0.497	8,050	1.8	131.0	3.36×10^{14}	3.40×10^{14}	382	3.479
			F 65	0.131/0.497	8,220	2.0	132.0	3.15×10^{14}	2.32×10^{14}	379	3.387
			F 65	0.131/0.496	7,620	2.0	132.0	3.15×10^{14}	3.87×10^{14}	379	3.454
			(avg.) F 65.5	0.132/0.497	7,860	1.8		(avg.) 3.22×10^{14}	(avg.) 3.20×10^{14}	(avg.) 380	(avg.) 3.439
					(avg.) 7,892	(avg.) 1.9					
15	Micarta 8457 G-10	Unheated control	E 83	0.126/0.493	39,400	3.2	130.0	3.76×10^{15}	4.64×10^{15}	377	
			E 83	0.123/0.496	43,000	3.3	128.0	3.04×10^{15}	1.70×10^{15}	391	
			E 83	0.125/0.497	44,700	3.6		(avg.) 3.14×10^{15}	(avg.) 3.40×10^{15}	(avg.) 384	
			(avg.) E 83.3	0.125/0.498	44,600	3.5					
					(avg.) 42,925	(avg.) 3.4					
		Three cycles of 40 hr at 300°F	E 83	0.126/0.500	42,100	3.3	131.0	3.73×10^{15}	1.23×10^{15}	382	0.185
			E 82	0.124/0.498	42,900	3.2	128.0	2.28×10^{15}	3.87×10^{15}	391	0.262
			E 81	0.125/0.494	45,300	3.4	130.0	4.70×10^{15}	4.64×10^{15}	385	0.169
			(avg.) E 82	0.126/0.500	38,100	3.0		(avg.) 3.57×10^{15}	(avg.) 3.25×10^{15}	(avg.) 386	(avg.) 0.205
					(avg.) 42,100	(avg.) 3.2					
16	XP-206 Fiberglass	Unheated control	—	0.497/0.0169	Transverse: 1,860	Longitudinal: 71,900	Transverse: 3.0	Longitudinal: 7	17.4	2.35×10^{15}	2.32×10^{15}	419	
				0.500/0.0175	2,000	71,300	3.0	7	17.3	1.97×10^{14}	2.01×10^{15}	428	
					(avg.) 1,930	65,700	(avg.) 3.0	6		(avg.) 1.44×10^{15}	(avg.) 2.17×10^{15}	(avg.) 424	
						62,800		6					
						(avg.) 67,900		(avg.) 6.5					
		Three cycles of 40 hr at 300°F	—	0.486/0.0161	4,370	73,700	8.0	5.0	18.4	1.47×10^{15}	2.01×10^{15}	380	0.117
				0.486/0.0164	3,990	81,900	8.0	5.0	17.7	1.79×10^{15}	2.01×10^{15}	316	0.152
				0.486/0.0166	3,350	83,000	10.0	5.0	17.5	2.34×10^{15}	1.85×10^{15}	303	(avg.) 0.135
				0.489/0.0158	(avg.) 3,905	75,200	(avg.) 8.7	5.0		(avg.) 1.87×10^{15}	(avg.) 1.96×10^{15}	(avg.) 333	
						(avg.) 78,500		(avg.) 5.0					

Table B-8. Thermal sterilization test data for tapes

No. (Table 14)	Commercial designation	Thermal exposure conditions	Adhesion[a], oz/in. width (5-in. average length) separation	Electrical properties				Physical properties
				Thickness, mil	Volume resistivity[b], Ω-cm	Surface resistivity[b], Ω	Dielectric strength[b], v/mil	Weight loss[c], %
1	Mystik 7000	Unheated control	36.0	9.8	2.49×10^{14}	2.78×10^{14}	500	
			30.0	9.8	3.24×10^{14}	9.29×10^{14}	530	
			33.0	9.8	2.74×10^{14}	7.74×10^{14}	485	
			(avg.) 33.0		(avg.) 2.82×10^{14}	(avg.) 6.61×10^{14}	(avg.) 505	
		Three cycles of 40 hr at 300°F	(avg.) 43.2	9.8	2.24×10^{14}	2.16×10^{14}	617	1.165
				9.8	2.24×10^{14}	1.59×10^{14}	595	1.373
				9.8	2.99×10^{14}	1.70×10^{14}	617	(avg.) 1.279
					(avg.) 2.49×10^{14}	(avg.) 1.82×10^{14}	(avg.) 609	
3	Scotch Tape No. 67, Electric Tape	Unheated control	(avg.) 25.6 (Tape failed after 1-in. separation)	5.4	2.18×10^{14}	7.70×10^{14}	1,070	
				5.4	3.15×10^{14}	1.39×10^{15}	1,100	
				5.3	2.97×10^{14}	1.31×10^{15}	1,110	
					(avg.) 2.77×10^{14}	(avg.) 1.16×10^{15}	(avg.) 1,093	
		Three cycles of 40 hr at 300°F	Tape failed	4.6	2.61×10^{14}	2.63×10^{14}	1,160	2.243
				4.5	2.37×10^{14}	1.85×10^{14}	1,100	2.783
				4.5	1.78×10^{14}	2.01×10^{14}	1,030	(avg.) 2.513
					(avg.) 2.25×10^{14}	(avg.) 2.16×10^{14}	(avg.) 1,097	
4	Tape No. 27	Unheated control	32.0	7.0	3.27×10^{14}	1.00×10^{13}	330	
			43.0	7.1	2.04×10^{14}	1.62×10^{13}	345	
			38.0	7.1	2.68×10^{14}	4.33×10^{13}	337	
			(avg.) 38.0		(avg.) 2.66×10^{14}	(avg.) 2.31×10^{13}	(avg.) 337	
		Three cycles of 40 hr at 300°F	Tape failed	7.1	1.43×10^{15}	5.57×10^{13}	211	5.374
				7.1	1.21×10^{15}	9.29×10^{13}	205	5.336
				7.1	6.44×10^{14}	1.47×10^{14}	314	(avg.) 5.355
					(avg.) 1.09×10^{15}	(avg.) 9.85×10^{13}	(avg.) 243	
5	Tape No. 7455	Unheated control	36.8	3.5	1.01×10^{15}	1.16×10^{15}	186	
			37.0	3.5	9.38×10^{14}	1.05×10^{15}	157	
			42.0	3.5	7.04×10^{14}	7.74×10^{14}	157	
			(avg.) 38.6		(avg.) 8.84×10^{14}	(avg.) 9.94×10^{14}	(avg.) 166	
		Three cycles of 40 hr at 300°F	37.8	3.7	1.17×10^{15}	2.71×10^{15}	175	0.995
			32.6	3.7	9.57×10^{14}	3.09×10^{15}	175	1.092
			32.0	3.7	1.03×10^{15}	2.71×10^{15}	203	1.068
			(avg.) 34.1		(avg.) 1.05×10^{15}	(avg.) 2.83×10^{15}	(avg.) 184	(avg.) 1.052

[a]ASTM D1000–62.

[b]ASTM D257.

[c]Weight loss determined using a Mettler Balance, Model H15, accurate to ±0.1 mg.

APPENDIX C

Description of Polymeric Products that Required Preparation Prior to Testing

This Appendix provides brief descriptions of the adhesives, coatings, and encapsulants that required preparation prior to their use as test specimens. Mixing ratios, pot lives, methods of application and cure times are given wherever applicable.

The following general rules were applied for preparation of the products:

1. The accuracy of volume and weight measurements was below 3% of error.

2. Filled systems first were mixed thoroughly in their original containers before sampling. Motor driven stirrers were used where possible, and stirring lasted at least 15 minutes.

3. Materials were sampled into glass or plastic containers wherever combination with a curing agent or thinner was necessary; stainless steel or ceramic spatulas were used for mixing. (Paper cups, wooden tongue depressors, and ice-cream sticks were avoided.)

4. Mixing was continued 3 to 4 minutes for small samples (100 grams or less), and appropriately longer for larger samples.

5. Particularly in the case of encapsulants, the mixture was degassed prior to casting to remove trapped air bubbles. Degassing continued until foaming subsided.

6. Care was taken to avoid undue exposure of materials to the atmosphere. Fresh mixes of the materials were used as much as possible.

To clean the following uncured products, the solvents indicated are recommended:

epoxies: methyl ethyl ketone (MEK), acetone, 1, 1, 1-trichloroethane, methylene chloride
polyurethanes: acetone, MEK
silicones: toluene, xylene
alkyds: xylene
neoprene: xylene, toluene
vinyls: acetone, MEK
polyesters: MEK, acetone
polysulfides: MEK

Table C-1. Preparation of adhesives

Product name and manufacturer	Material type	Mixing ratio	Pot life at room temperature	Cure time and temperature
A-4000, Dow Corning Adhesive	Solvent-based adhesive, 70% silicone and 30% xylene, catalyst is equal parts by weight of dibutyltin di-2-ethylhexoate and xylene	46.2 g A-4000 to 2.08 g A-4000 catalyst	4 to 8 hr	18 hr at 120°F
Bonding Agent R-823, Carl H. Biggs	Thermosetting epoxy resin, amine catalyzed; colorless, 600 cps viscosity, 100% solids	50 g R-823 to 3 g hardener D	1 hr	20 hr at room temperature, plus 2 hr at 212°F
No. 206 Cement, Caram	Solvent-based neoprene adhesive; opaque, brown, medium viscosity	Use from can thoroughly mixed; apply with metal spatula	—	72 hr at room temperature
EC 1103, 3M Co.	Solvent-based (petroleum naphtha and toluene) vinyl resin; transparent, colorless, low viscosity	Use from can thoroughly mixed; apply with metal spatula	—	24 hr at room temperature
EC-1614 B/A, 3M Co.	Two-part epoxy-based adhesive, polyamide catalyzed; tan, 100% solids	100 g Part A to 100 g Part B	¾ hr	48 hr at room temperature
EC 2216 B/A, 3M Co.	Two-part epoxy-based adhesive, amine catalyzed; off-white, 100% solids.	Three parts A to two parts B, by volume	2 hr	24 hr at room temperature
Eccobond 26 A/B, Emerson and Cuming	Two-part epoxy adhesive; off-white, 100% solids	Equal parts of A to B, by volume	¼ hr	24 hr at room temperature
Eccobond 55/9, Emerson and Cuming	Epoxy-based adhesive, amine catalyzed; low viscosity, 100% solids	44.7 g base to 5.6 g Catalyst No. 9	½ hr	30 hr at room temperature
Eccobond 55/11, Emerson and Cuming	Epoxy-based adhesive, amine catalyzed; low viscosity, 100% solids	31.5 g base to 5.4 g of Catalyst No. 11	4 hr	½ hr at 300°F
Eccobond Solder 56C/9, Emerson and Cuming	Epoxy-based adhesive, amine catalyzed; silver powder-filled, conductive	18.09 g base to 0.45 g Catalyst No. 9	1 hr	2 hr at 120°F
Eccobond Solder 57C A/B, Emerson and Cuming	Two-part epoxy adhesive, amine catalyzed; may be cured at room temperature; low resistance	32.25 g Part A to 32.25 g Part B	1 hr	1 hr at 200°F
Epon 8/A, Shell Chemical	Two-part epoxy adhesive paste, thixotropic, amine catalyzed; 100% solids	74.75 g base to 4.5 g Catalyst A	2½ hr	1½ hr at 200°F
Epon 422, Shell Chemical	Epoxy-phenolic-based tape adhesive; glass fabric-supported	—	—	½ hr at 330°F
Epon 828/A, Shell Chemical	Epoxy resin, amine catalyzed; light-colored, 100% solids, low viscosity (100 to 160 poises at 25°C)	62.0 g base to 3.7 g Catalyst A	3 to 4 hr	2 hr at 235°F
Epon 828/Z, Shell Chemical	Epoxy resin, amine catalyzed; light-colored, 100% solids, low viscosity (100 to 160 poises at 25°C)	100 g base to 20 g Catalyst Z	8 hr, for quantities less than 1 quart	2 hr at 175°F, plus 2 hr at 300°F
Epon 901/B-1, Shell Chemical	Two-part epoxy adhesive, thixotropic; red, buttery consistency	63.25 g base to 14.5 g Catalyst B-1	¾ hr	1 hr at 200°F
Epon 901/B-3, Shell Chemical	Two-part epoxy adhesive, thixotropic; gray, buttery consistency	43.0 g resin to 4.75 g Catalyst B-3	6 hr	½ hr at 240°F, plus 1½ hr at 350°F
Epon Pipelok 924 A/B, Shell Chemical	Two-part epoxy pipe joint sealer and adhesive, thixotropic; red when mixed	100 g Part A to 25 g Part B	½ hr	6 hr at room temperature
E-Solder 3022, Epoxy Products Co.	Epoxy solder-adhesive, amine catalyzed; silver powder-filled, 100% solids	20 g base to 1.6 g No. 18 hardener	1 to 3 hr for quantities less than 50 g	1½ hr at 185°F

Table C-1 (cont'd)

Product name and manufacturer	Material type	Mixing ratio	Pot life at room temperature	Cure time and temperature
FM 96, American Cyanamid	Modified epoxy-polyamide adhesive; light nylon fabric-supported	—	—	1 hr warm-up of press to 350°F, plus 1 hr at 350°F under 40 psi pressure
FM 1044, American Cyanamid	Epoxy-polyamide film adhesive; light tan, unsupported	—	—	¾ hr at 340°F under 200 psi pressure
GT 200, Schjeldahl	Polyester resin in chlorinated solvent; thermoplastic, heat sealable	—	—	1 hr at 104°F
HT 424, American Cyanamid	Epoxy-phenolic adhesive film; gray, unsupported[a]	—	—	1¾ hr at 350°F under 40 psi pressure
Hysol 5150/3690, Hysol of California	Epoxy adhesive, modified amine catalyzed; cured at room temperature, 100% solids	31.25 g of Hysol 5150 to 31.25 g of Catalyst 3690	2 hr for quantities of less than 100 g	72 hr at room temperature
No. A2 Adhesive/A, Armstrong Products	Two-part epoxy-based adhesive, cured with amine-type catalyst; 100% solids	97.0 g base to 3.5 g hardener	2 to 3 hr	2½ hr at 200°F
PC 12-007 A/B, Hysol of California	Epoxy coating, thixotropic, amine catalyzed; pale yellow, very high viscosity	42.8 g Part B to 53.6 g Part A	3 hr	2½ hr at 167°F
Proseal 501 Adhesive, Coast Proseal	Two-part polysulfide-based adhesive; cured at room temperature; flexible, translucent, 96% solids	100 g base to 30 g No. 501 catalyst	1½ hr at 60°F	48 hr at room temperature
RTV 102, General Electric	RTV silicone adhesive or sealant, thixotropic; opaque, white, solventless	Use direct from tube	1 hr tack-free time	1 week at room temperature; cure complete when acetic acid odor is undetectable
RTV 108, General Electric	Silicone elastomer, thixotropic paste; soft, spreadable; flexible with air-cure	Use direct from tube	Tack-free time of ½ hr at 50% relative humidity	1 week at room temperature and 50% relative humidity; cure complete when acetic acid odor is undetectable
RTV 140, Dow Corning	Silicone; ready to use; translucent, buttery consistency	Use direct from tube	1 hr tack-free time	1 week at room temperature; cure complete when acetic acid odor is undetectable
RTV 891, Dow Corning	RTV silicone elastomer; ready to use; opaque, white	Use direct from tube	Tack-free time of 1 hr at 50% relative humidity	96 hr at room temperature and 50% relative humidity; cure complete when acetic acid odor is undetectable

[a]Method of application: apply a thin layer of HT 424 primer to metal surface; cure at least 1/2 hr at room temperature, plus 1 hr at 150°F; place sheet of adhesive on primed surface.

Table C-2. Preparation of coatings

Product name and manufacturer	Material type	Mixing ratio	Method of application	Pot life at room temperature	Cure time and temperature
Alkenex Varnish 9522, General Electric	Modified alkyd polyester-based coating; amber colored	Use from can, thoroughly mixed	Brush	—	2 hr at room temperature plus 4 hr at 100°F
B-224-2 Tuffernell Varnish, Westinghouse	Alkyd insulating varnish; clear, air-dried	As supplied by vendor; thinning: 2 parts B-224-2 Varnish, 1 part xylene, 1 part BS-107 thinner (Westinghouse)	Spray	—	6 hr at 25°C
Cat-A-Lac 443-1 Gloss White, Finch Paint and Chemical	Unesterified epoxy-resin system, the catalyst a combination of primary amines	100 g base to 3.6 g catalyst; thinning: 1:1 with TL-29 reducer	Spray over primed surface; surface primed with a mix of 1 part catalyst with 3 parts Finch No. 463-4-8 primer base by volume, thinned with 35% by volume TL-26 reducer, dried 1 hr at room temperature	18 to 24 hr	7 days at room temperature
Cat-A-Lac 463-1 Flat White, Finch Paint and Chemical	Unesterified epoxy-resin system, the catalyst a combination of primary amines	100 g base to 2.5 g catalyst; thinning: 1:1 with TL-29 reducer	Spray over primed surface; surface primed with a mix of 1 part catalyst with 3 parts Finch No. 463-4-8 primer base by volume, thinned with 35% by volume TL-26 reducer, dried 1 hr at room temperature	18 to 24 hr	7 days at room temperature
Cat-A-Lac 463-1-8 Flat Black, Finch Paint and Chemical	Unesterified epoxy-resin system, the catalyst a combination of primary amines	100 g base to 2.5 g catalyst; thinning: 1:1 with TL-29 reducer	Spray over primed surface; surface primed with a mix of 1 part catalyst with 3 parts Finch No. 463-4-8 primer base by volume, thinned with 35% by volume TL-26 reducer, dried 1 hr at room temperature	18 to 24 hr	7 days at room temperature
Corlar 585/586, Du Pont	Two-part epoxy enamel, gloss black	Equal volumes of resin and activator; mix thoroughly; thinning not necessary	Spray over primed surface; surface primed with a mix of ½ pint Du Pont T-3871 thinner to one gallon of Du Pont 583 Zinc Chromate primer; spray thinned primer and air dry at room temperature for one hour; spray an unthinned top coat	3 days	72 hr at 70°F
D25W2 Speedprint Ink, Sherwin-Williams	—	Mix thoroughly in the can; thinned with 10% by volume toluene	Rubber roller	—	24 hr at room temperature
Electrofilm Lube-Lok 2396, Electrofilm Corporation	Sodium silicate-based, resin-bonded coating; contains molybdenum disulfide and graphite; opaque, gray	Mix thoroughly in the can; thinning: 1:1 by volume with distilled water	Spray, allowing solvent to evaporate between coats until surface is shiny	—	After final spray, solvent allowed to evaporate for 1 hr; cured for 2 hr at 180°F plus 2 hr at 400°F

Table C-2 (cont'd)

Product name and manufacturer	Material type	Mixing ratio	Method of application	Pot life at room temperature	Cure time and temperature
Electrofilm Lube-Lok 4306, Electrofilm Corporation	Resin-bonded, molybdenum disulfide film lubricant; solid, opaque, dark khaki	Mix thoroughly in the can; thinning: 3 parts dioxane to 1 part base by volume	Spray, allowing solvent to evaporate between coats until surface is shiny	—	Solvent allowed to evaporate 1 hr; cured 1½ hr at 375°F
Eccocoat EC 200 A/B, Emerson and Cuming	Epoxy coating, amine catalyzed; clear, general purpose	—	Spray	24 hr	6 hr at room temperature
Eccocoat IC 2, Emerson and Cuming	Two-part polyurethane-based surface coating; clear	Warm part A to 120°F; mix 100 parts A to 50 parts B by weight	Brush	8 hr	Air-dried at room temperature 1 hr, plus 2 hr at 250°F
Eccocoat VE A/B, Emerson and Cuming	Epoxy surface coating; resilient, clear	1 part A to 1.5 parts B by weight; thinning: 30 parts base to 45 parts toluene by volume	Spray	4 hr	24 hr at room temperature
Eccosil No. 33, Emerson and Cuming	Silicone primer; transparent, pink	Use as supplied by vendor; mix thoroughly in can	Spray	—	24 hr at room temperature
Fungicidal Varnish 220F, Westinghouse	Alkyd-salicylanilide fungicidal varnish; clear, air-dried	Mix thoroughly in can; thinning: 1:1 with Westinghouse BS-107 thinner	Spray	—	5 hr at room temperature
Hi-Heat Aluminum Paint 171-A-28, Fuller Paint Co.	Aluminum-filled silicone paint; opaque	Mix thoroughly in can for complete dispersion of aluminum powder	Spray	—	1 hr at 450°F
Insul-X U86, Insul-X Products	Melamine-modified alkyd baking varnish; clear	Use as supplied by vendor	Spray	—	Allow solvent to evaporate for 1 hr at 75°F; bake for 3 hr at 250°F
Interchemical 12412, Interchemical Corporation	Phenolic butyrate primer or coating material; gloss-black opaque	Mix thoroughly in can; thinning: 3 parts base to 1 part Interchemical No. 75 Paladin thinner	Spray	—	Three days at room temperature
Number 73-X Ink, Independent Ink Co.	Marking ink; opaque, black	Use as supplied by vendor	Rubber stamp and pad	—	24 hr at room temperature
Number 445 Silicone Water Repellant, Sinclair	Silicone-based water-repellant paint; clear	Use as supplied by vendor	Spray; allow solvent to evaporate between coats	—	24 hr at room temperature
Number 7575-#515, Fuller Paint Co.	Alkyd-modified silicone; opaque, black, heat resistant	Thin 4 parts base with 1 part No. 7536 Airtec Reducer (Fuller)	Spray	—	24 hr at room temperature

Table C-2 (cont'd)

Product name and manufacturer	Material type	Mixing ratio	Method of application	Pot life at room temperature	Cure time and temperature
Perma-Dri Ink 177, Acme Marking Co.	Marking ink; fast drying, opaque, black, glossy	Use as supplied by vendor	Rubber stamp and pad	—	24 hr at room temperature
PR 1902, Products Research Co.	Silicone primer; blue, hygroscopic	Use as supplied by vendor	Spray	—	24 hr at room temperature
Pyre-ML Varnish RK 692, Du Pont	Polyimide varnish; high temperature	Use as supplied by vendor	Preheat varnish ½ hr at 350°F; apply with brush when temperature of varnish is below 300°F	—	1 hr at 212°F, plus 1 hr at 300°F, plus 1 hr at 420°F
SR 290, General Electric	Silicone varnish; fast curing, flexible, insulating	1:1 by volume of G.E. SR-98 and G.E. SR-17	Spray	—	24 hr at room temperature
Uralane 241/973, Furane Plastics	Polyurethane coating; clear	10 g Hardener 973 to 100 g Uralane 241	Spray	—	24 hr at room temperature

Table C-3. Preparation of encapsulants

Product name and manufacturer	Material type	Mixing ratio	Pot life at room temperature	Cure time and temperature
Eccosil 5000, Emerson and Cuming	Silicone foam, syntactic, RTV; Part A, a reddish thin paste; Part B, red, hollow spheres of cured silicone rubber	100 g of Part A to 270 cm^3 of Part B	1 hr	24 hr at room temperature, plus 2 hr at 250°F
Epocast 202/9615, Furane Plastics	Amber liquid of medium viscosity (ca. 3 cps); clear, unfilled	60 parts of hardener to 100 parts of resin, by weight; degas for 10 min below 3 mm pressure	1½ hr	48 hr at room temperature
Epocast 212/951, Furane Plastics	Epoxy resin system, thermosetting; low viscosity; clear, amber, unfilled	12 parts of hardener to 100 parts resin, by weight	1½ hr	24 hr at room temperature
Hapex 1200A/Hardener 1210, Hastings Plastics	Epoxy casting system; 100% reactive; low viscosity (3000 to 5000 cps)	No ratio given; add Part A to Part B in the quantities given, mix thoroughly with metal spatula; degas below 3 mm pressure for 10 min	6 to 8 hr	2 hr at 180°F
Hysol 4248, Hysol of California	Epoxy casting resin; unfilled[a]	Warm resin to 90°F and degas for 10 min below 3 mm pressure	—	6 hr at 300°F
Number 5712 (Uralane), Furane Plastics	Polyurethane potting or molding compound	50 parts hardener to 100 parts base by weight; mix and degas for 10 min below 3 mm pressure	1 hr	16 hr at 180°F
PR-1930-2/PR 1902, Products Research Co.	Two-part RTV silicone; base is brick red and accelerator is green[b]	1 part accelerator to 10 parts base, by weight	2 hr	72 hr at room temperature
Proseal 777, Coast Proseal	Two-part polysulfide encapsulating and potting compound; low viscosity	Entire contents Part A to entire contents Part B	1½ hr	6 hr at 180°F, plus 1 hr at 275°F
RTV-G-310, Hysol of California	Two-part silicone compound; paste consistency, high elongation	4 parts catalyst to 100 parts base, by weight	2 to 4 hr	24 hr at room temperature
RTV 11/Thermolite 12, General Electric	Two-part RTV silicone compound; white, low viscosity	100 g base to 0.5 g catalyst, mix thoroughly; degas 10 min below 3 mm pressure	1 to 2 hr	48 hr at room temperature
RTV 60/Thermolite 12, General Electric	Two-part RTV silicone compound; medium viscosity	100 g base to 0.5 g catalyst, mix thoroughly; degas 10 min below 3 mm pressure	1 to 2 hr	24 hr at room temperature
RTV 881, Dow Corning	Two-part RTV silicone compound; white	100 parts base to 4 parts catalyst, by weight	3 hr	24 hr at room temperature
RTV 881 plus Cab-O-Sil, Dow Corning	Two-part RTV silicone elastomer; white, viscosity about 5×10^4 centistokes	50 parts base to 2 parts catalyst 881, plus 1 part Cab-O-Sil, by weight; add 8 drops Thermolite T-12 catalyst; mix thoroughly and degas 10 min below 3 mm pressure	3 hr	24 hr at room temperature
RTV 881 plus DC 200, Dow Corning	Two-part RTV silicone elastomer; white	To RTV 881, add 2% by weight of DC 200 fluid	About 3 hr	24 hr at room temperature
Scotchcast 260, 3M Co.	Epoxy resin; green powder	Pour powder into mold	—	½ hr at 400°F
Scotchcast Resin No. 3, 3M Co.	Two-part thermosetting epoxy; oven-cured, very low viscosity, unfilled, 100% solids	2 parts A to 3 parts B, by weight	3 to 4 days	16 hr at 170°F

[a]Method of application: warm mold to 90°F; pour warm, degassed material into mold.

[b]Method of application: spray a 0.5 mil thick layer of PR 1902 primer on fully cured material.

Table C-3 (cont'd)

Product name and manufacturer	Material type	Mixing ratio	Pot life at room temperature	Cure time and temperature
Scotchcast Resin 241 A/B, 3M Co.	Two-part epoxy resin; oven-cured, filled, brown, semiflexible	1 part A to 2 parts B, by weight	3 to 4 days	6 hr at 205°F
Solithane 113/300, Thiokol Chemical Co.	Polyurethane system; pale yellow	100 g Solithane 113 to 73 g Catalyst No. 300; mix thoroughly, degas 10 min below 3 mm pressure	3 hr	1 hr at 300°F
Solithane 113/300/328/ T-12, Thiokol Chemical Co.	Polyurethane system; pale yellow	100 g Solithane 113 to 36.5 g Catalyst No. 300, plus 7.5 g Catalyst No. 328, plus 4 drops of Thermolite T-12; mix thoroughly, degas 10 min below 3 mm pressure	1 hr	1 hr at 300°F
Solithane 113/300/Calcofluor, Thiokol Chemical Co.	Polyurethane system; medium viscosity, pale yellow	100 g Solithane 113 to 73 g Catalyst No. 300, plus 0.2 g Calcofluor; mix thoroughly, degas 10 min below 3 mm pressure	3 hr	1 hr at 300°F
Stycast 1090/9, Emerson and Cuming	Epoxy casting resin, amine catalyzed; opaque, black, rigid, low weight solid	100 g Stycast 1090 to 9 g Catalyst No. 9; mix, degas 10 min below 3 mm pressure	½ hr	24 hr at room temperature
Stycast 1090/11, Emerson and Cuming	Epoxy casting resin, amine catalyzed; opaque, cures to black, rigid, low weight solid	100 g resin to 25 g Catalyst No. 11; mix, degas 10 min below 3 mm pressure	½ hr	2 hr at room temperature
Stycast 1264 A/B, Emerson and Cuming	Epoxy casting resin; water clear	100 g of Part A to 45 g Part B; mix, degas 10 min below 3 mm pressure	3 hr	3 hr at 150°F
Stycast 2651/11, Emerson and Cuming	Two-part epoxy casting resin, amine catalyzed; black, viscosity about 1500 poises	100 g base to 8 g Catalyst No. 11; mix, degas 10 min below 3 mm pressure	4 hr	2 hr at 165°F, plus 2 hr at 220°F
Stycast 2741/15, Emerson and Cuming	Two-part epoxy casting resin, amine catalyzed; black	100 g resin to 150 g Catalyst No. 15	2 hr	½ hr at room temperature
Stycast 2850 GT/9, Emerson and Cuming	Two-part epoxy casting resin, amine catalyzed; opaque, black	100 g resin to 3 g Catalyst No. 9; mix, degas 10 min below 3 mm pressure	1½ hr	24 hr at room temperature
Stycast 3050/9, Emerson and Cuming	Two-part casting resin, amine catalyzed; reddish-brown, low viscosity	100 g resin to 7.5 g Catalyst No. 9	½ hr	1 hr at 160°F
Sylgard 182, Dow Corning	Two-part silicone resin; transparent, solventless	100 g resin to 10 g curing agent; mix, degas 10 min below 3 mm pressure	6 to 8 hr	4 hr at 300°F
Sylgard 184, Dow Corning	Two-part RTV silicone resin system; transparent	100 g resin to 10 g curing agent; mix, degas 10 min below 3 mm pressure	2 hr	24 hr at room temperature, plus 1 hr at 150°F

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